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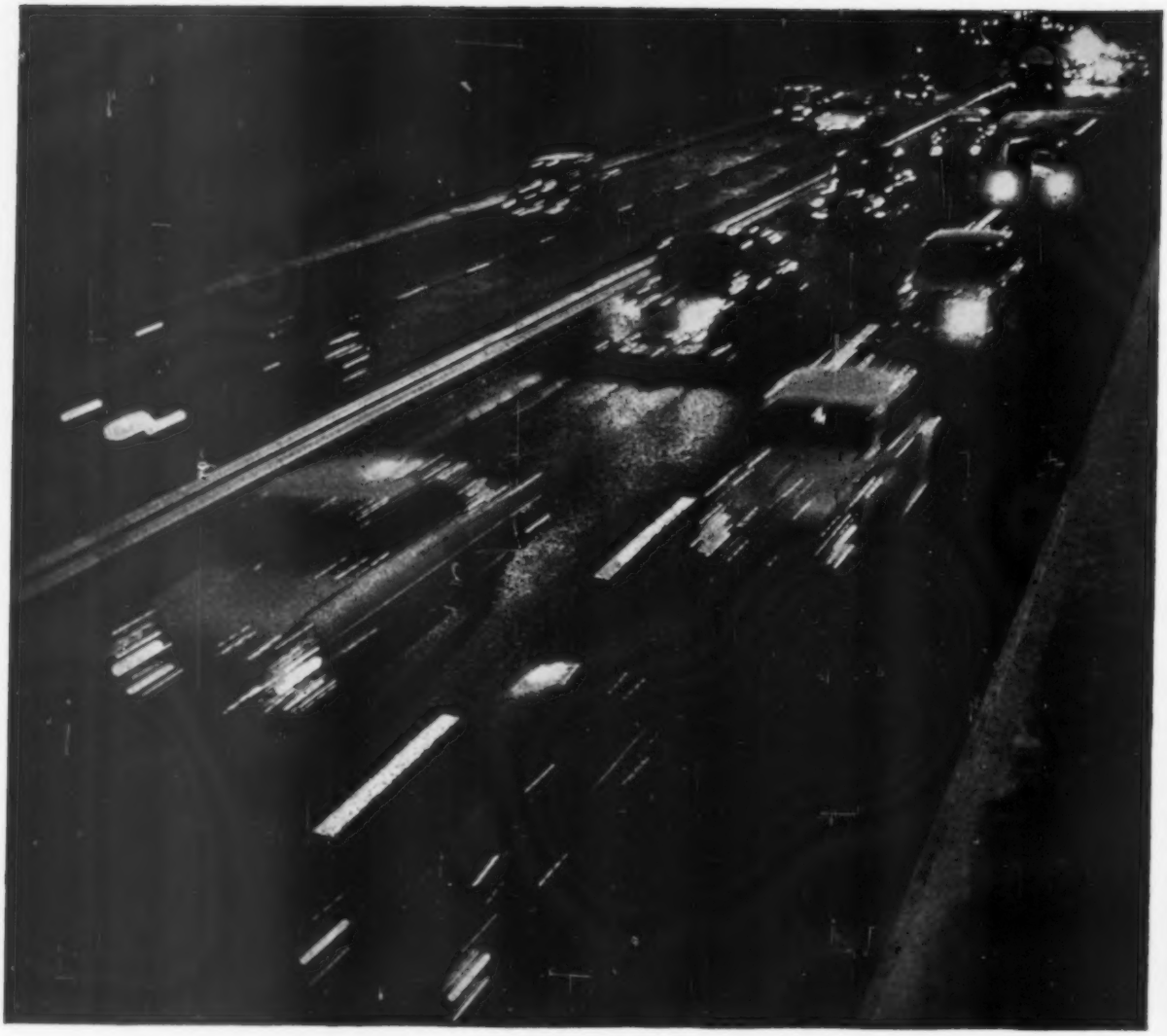

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VOLUME 2 No. 6 OCTOBER 1960

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Parliamentary Debate

PARLIAMENT reassembles on October 25, and, before it prorogues three days later, transport is to be debated. Although the debate will be on the annual report and account of the British Transport Commission and the report of the Select Committee on Nationalized Industries on Railways, between them they cover sufficiently wide a field to permit a general discussion on transport policy. It is, therefore, to be hoped that the Minister of Transport will take the opportunity to define more clearly the Government's intentions in regard to transport policy and in particular to the future role that both road and rail are to be called upon to play. This Journal is mainly concerned with roads and their traffic but no particular means of transport can operate in complete disregard of other modes of transport. This is especially so as regards road transport since future needs are to a large degree bound to be conditioned by the extent to which the railways are to continue as major carriers of passengers and goods. Their share of traffic will be dependent upon the carrying through of the modernization programme. It is therefore important that Government decisions on the recommendations of the Stedeford Advisory Group, which is considering its future, be announced in time for the debate. Most important of all is confirmation or denial of the current report that it is proposed to curtail the railway electrification programme. If it is to be restricted, unless all previous calculations as to the comparable merits of dieselization and electrification on which the programme was based are wrong, the economics of road and rail carrying will be affected, and the roads will probably be called upon to carry more than would otherwise be the case, and that would affect road requirements.

Heretofore, it appears that the respective road and railway capital investment programmes have developed separately and insufficient regard has been given to their inter-relationship. On the roads side, by the application of traffic engineering methods, increasing data is becoming available as to the economic benefits that are obtained from new road construction. The Road Research Laboratory has developed means of assessing the benefits that are obtained from new road construction and improvements, which can assist in the determination of priorities. Similarly, traffic studies, such as those conducted in connection with the London-Birmingham and Birmingham-Preston sections of M1, as reported in previous issues of this Journal, provide information as to the extent to which traffic will be diverted to new roads and the economic benefits that can be expected to accrue. But similar information in regard to the benefits to be derived from capital investment in the railways is not available and, until it is, it will remain difficult to determine the comparable benefits that can be obtained for the community from investment in road and rail.

Meanwhile, because there is as yet insufficient use of traffic engineering methods, and because there are in any case limitations on what it can achieve, congestion on the roads, particularly in urban areas, grows worse. Consequently, nothing but advantage can be obtained from increasing co-operation between road and rail so that the most economic use is made of investment in both. Here the Roadrailer may make a valuable contribution by enabling goods to be transported in the same vehicle over road and rail. This is an extension of the 'piggy back' system which has been developed so successfully in America in recent years. But, however great the co-operation, and whatever role the railways are to play, the larger proportion of goods and persons carried by all forms of transport has its final destination in urban areas, and most journeys must start and end by road.

In this respect, the roads programme is still out of proportion. The motorway programme, urgent and important as it is in connecting the cities, is going ahead far faster than is the improvement of the road network within them. It is regrettable, therefore, that the Minister of Transport gives the impression that he is not favourably inclined towards urban motorways, fearing presumably their adverse effect on community life by thrusting their way through the heart of the cities on ugly structures. This certainly need not be so, as is shown by the construction of urban motorways in Berlin, which is the subject of an article in this issue. Provided, that traffic studies are made to assess need, the line of route is wisely chosen and its planning and final design is the work of a team comprising all concerned with urban development, harmful effects can be avoided.

Without new construction and major improvement urban road networks will be unable to cope with the traffic being generated by the motorways now being built. The traffic engineer can do much to relieve current congestion if given sufficient authority, and if his recommendations are carried out and any resultant controls are strictly enforced. But there is a limit to what he can achieve, and certainly without means, which in his case is an adequate road network, he cannot achieve his ends.

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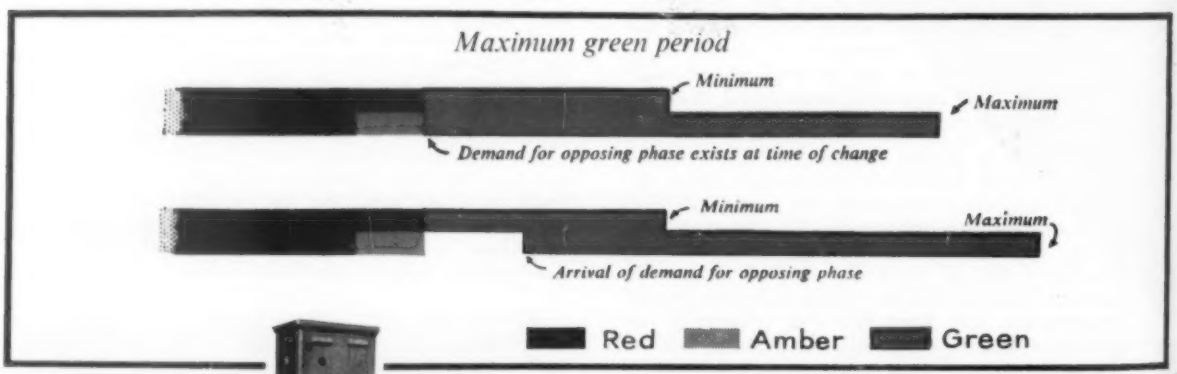

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Topics of the Month...

WITH the experience gained on the first motorways the standards that need to be laid down to meet the particular needs of their users become clearer. Although, regrettably, all the lessons M1 has to teach do not appear to have been fully learned, it is hoped no credence should be given to the report that because of the difficulty of agreeing tenders on the section from Birmingham to Preston standards are to be lowered. The more so as certain of those of the first section are now admitted to be lower than was desirable as is evidenced by the decision to widen the hard shoulders from eight to 10 feet. No doubt, this results not only from the difficulties encountered by drivers of heavy vehicles when compelled to draw off the carriageway, but also from the simple experiment conducted by the Road Research Laboratory, described in the Julv issue of this Journal. This showed that the wider the shoulder, the easier it was for the driver to dismount away from the carriageway and, although of the three widths tested—eight, 10 and 12 feet—the widest was the best from this point of view, other considerations enter in and the Ministry has compromised on a 10-foot shoulder, against the 11½ foot provided on the Lancaster by-pass, which, however, has only two-lane carriageways.

Dark Motorways

Gratifying as is the Minister's decision to go ahead with this improvement, in contrast, it is regrettable that Mr. J. F. A. Baker, Chief Engineer (Highways), speaking for the Ministry at the Folkestone Conference of the Association of Public Lighting Engineers, reported elsewhere in this issue, announced that it was not proposed to provide lighting on the rural motorways nor at their intersections, but only at the roundabouts at their terminals. He claimed that the experience on M1 did not justify a change of policy. This is contrary to experience abroad where it is standard practice—in the United States for instance—to light all entrance and exit lanes and ramps. Presumably the Ministry decision is not based on the rejection of American standards, nor can it dispute the much contended view, backed by convincing data, that the economic use of a motorway increases, and the danger of accidents decreases when lighted. With limited funds available the Ministry apparently has decided that, for the present, the considerable expenditure involved in lighting their total length could be better employed otherwise in the roads programme. That may be so, but lighting of the intersections would not be a large item compared with total costs and maintenance and it is hoped that after due consideration this far too sweeping decision against illumination will be revised.

Another economy which it is understood is being considered, and which, although on a smaller scale, it is even more difficult to justify, is the possibility of dispensing with telephones along the Birmingham to Preston Motorway. Those on the earlier section have been in frequent use for emergency calls, reaching, it is believed, some 1,500 calls a month on occasion, so the cost of their installation which cannot be great would appear to be fully merited. It can represent only a small percentage on the capital cost of the motorway, and the provision of emergency services and the policing of the motorways will be far more difficult and costly if no telephones are available. In fact, already the police arrangements are far from satisfactory. This is not only because the motorways run through several counties, each with its own constabulary, but also because the Home Office has so far not agreed to permit an increase in establishments for the policing of the motorways. Since policing of the roads from which traffic is diverted must also be continued the same manpower is called upon to do more work which adds an impossible burden to already under-manned forces and threatens to reduce their efficiency. In these circumstances, consideration might be given to the creation of special motorway police patrols to ensure continuity and uniformity of practice along the whole length.

Vehicle Testing

The Road Traffic Act authorizing a vehicle testing scheme received the Royal Assent in July 1956. It started on a voluntary and limited basis in September 1960. It may not become compulsory before the end of the year, and it would be interesting to know how many accidents would have been avoided, lives saved and other casualities averted had testing become compulsory earlier. Excuses for the long delay are legal difficulties and the time necessary to enrol and inspect the authorized testing stations. Possibly these excuses would be more acceptable were the scheme as now instituted comprehensive, free from suspicion and certain to achieve the desired result. Unfortunately, this is not the case. Initially, the tests are confined to 10-year old vehicles and are limited to brakes, lights and steering, and are to be conducted for the most part by 12,500 private garages.

No doubt, in the early and experimental stages of the scheme it would have been impossible to make the test all-embracing, but it should be progressively extended and as speedily as possible until a certificate of road worthiness is the prerequisite to vehicle registration. The main shortcoming of the present scheme, which will remain even when it is extended and becomes compulsory, is employment of private garages for the test. Car owners, rightly or wrongly, lack faith in the objectivity of garage operators who they fear will be unable to segregate their function of testing from vehicle servicing and repair which is their bread and butter. This difficulty could only be avoided if the Ministry and the municipalities alone had responsibility for conducting the tests. This was rejected by the Government on grounds of cost. This is unconvincing since a few municipalities have set up testing stations and, because the fees are not inconsiderable, should be adequate to meet the costs involved.

Traffic Congestion and LONDON'S BUSES

by A. T. Wilford, *B.Sc., A.R.C.S., C.I.Mech.E., F.Inst.Pet.*
Director of Research, London Transport Executive

The Routemaster.

THE most noticeable effect of road traffic congestion is an increase in journey times between given points. To a limited extent this situation is taken for granted, and it is tacitly accepted that the journey into London on Monday mornings and the outward journey on Friday evenings will be more onerous than on other days, and that a shower of rain, particularly after a dry spell, will lead to more than the usual number of delays. But there is more to it than this, for it is common experience that because of variations in the amount of congestion, often occurring quite rapidly, the magnitude of the increase in journey times is largely unpredictable. It is this fact which bears so heavily on public transport whose vehicles operate to a schedule. Although the schedules are adjusted in respect of sections of route and to a limited extent by time of day, to make allowances for mean variations in traffic congestion, the range of variation is so wide as to cause serious disturbance to headways. The service thus becomes irregular, and may eventually reach the stage at which the vehicles become bunched together with extended gaps in between, a close-interval service being especially vulnerable. It can be shown that with regular departures from one point, if more than about one-third of the buses running on a route have journey times differing from average by more than an amount equal to the headway, their arrival at a point outside the congested area will be in random form, i.e. the probability of a vehicle arriving at any instant will be independent of the time which elapses since the last vehicle arrived. Unfortunately this condition is often fulfilled with buses operating on routes running throught the City and the West End of London. Passenger waiting times are thereby increased, buses which are unable to complete their scheduled mileage may have to be turned or withdrawn, potential riders are lost, and so too in the long-term is passenger goodwill. As will be shown later, in addition to its adverse effect upon operating costs, traffic congestion also leads to an increase in running costs.

The unpredictability of journey times through Central London and the busier suburbs is due to a number of causes which need only be briefly mentioned here. They include the ever growing number of vehicles, especially private cars, using the roads; parking of cars, not only on busy traffic routes, but in side streets which might otherwise be free for traffic movement; loading and unloading of traders' vans on main thoroughfares; narrow or narrowing roadways; inadequate intersections, particularly those involving a right-turn; indiscriminate pedestrian movements, etc. These adverse factors affect all road users, though generally speaking the greatest number of people affected are those carried by public transport. It is not out of place to recall that in both Europe and the United States more regard is paid to the needs of public transport than is normally the case in London and other cities of Great Britain. The problem, at least during the morning and evening peaks, is, or ought to be, not only one of effecting a maximum flow of vehicles but of people also, and it is in this respect that the London bus, with its 61 seated and standing passengers (69 in the case of the new RM bus) can claim to be a more efficient means of transport than the private car, with an average of 1.5 occupants.

The extent to which London Transport can engage in traffic engineering studies is inevitably somewhat limited; there are many competing problems which make demands on its operational research and other scientific staff. The undertaking is in a position to provide factual information on journey times and causes of delays, and in support of measures which would be expected to facilitate the operation of its own and other vehicles. The data must, however, be specific and representatively based, and seldom arise automatically from records, e.g. lost mileage due to traffic causes, lateness of buses at timing points, and

others normally maintained. It is necessary, therefore, to carry out special studies in which the scientific staff are assisted by teams of observers temporarily seconded from other departments. Such projects have on occasion involved as many as 40 individuals working in shifts for periods of up to a fortnight, excluding the additional time required for analysis and presentation of results.

The following examples of this work have been selected as illustrative of various factors, both adverse and beneficial, which affect the operation of buses.

Survey Results

Surveys carried out over a period of time on the busiest portion of Route 14 between Hyde Park Corner (St. George's Hospital) and Euston Station (via Piccadilly, Shaftesbury Avenue and Tottenham Court Road) have provided valuable information on the causes and duration of delays encountered when running through this section (2.5 miles in length) which includes 48 traffic-lighted and police-controlled intersections (23 on the northbound route and 25 on the southbound). The observers work to a pre-planned timetable which has been maintained substantially unchanged in each survey. From the data obtained it is possible to extract bus journey time and stopped time at each traffic light and police-controlled intersection, pedestrian crossing and bus stop. The difference between the total journey time and the stopped time is taken to be the time in motion.

The first of these surveys was made over two weeks (Monday to Friday only) during September/October 1952, and a second during a fortnight in May 1955. The next survey was carried out during January 1957 when fuel rationing was in force following upon the Suez conflict. There was another survey in November 1958 and two more were undertaken during the time that the 'Pink Zone' regulations were in operation, one covering the period December 17 to 23, 1959, excluding the weekend, the other being spread over the two weeks ended January 13, 1960. The observations were made between the hours of 8.0 a.m. and 6.0 p.m. The results of the six surveys broken down to show stopped time, time in motion and total journey time, each being the average derived from all journeys both northbound and southbound, are shown in Table I.

It will be observed that there was a marked increase in average bus journey time in May 1955 compared with September/October 1952, the increase being due to longer delays at traffic lights, police-controlled crossings and pedestrian crossings. Information derived from Road Research Laboratory automatic traffic counter records suggests that May and September/October are similar periods within any given year in respect of traffic density, and it is evident that the longer delays encountered in the 1955 survey were attributable to the increase in traffic congestion since 1952. The effect of the reduction in volume of traffic, mainly private cars, consequent upon fuel rationing is clearly demonstrated by the results of the January 1957 survey. Total stopped time was but little different from that found in 1952, but total journey time was less, this being due to a decrease of time in motion (i.e. an increase in speed between stops). There was, in fact, evidence that journey times through this section of route could have been even further reduced had it been feasible to revise the schedules. The comparative ease with which buses were able to keep within schedules, not only on Route 14, but on all routes, was a notable feature of the fuel rationing period.

In November 1958, a month of the year when traffic is expected to be below average density, conditions were as adverse as those of May 1955, average delays at traffic lights, police-controlled crossings and pedestrian crossings taken together being within a few seconds of those previously recorded, whilst total journey time was only 0.3 minutes (18 seconds) less in a period of about 20 minutes. Having regard to the general increase in density of traffic between 1955 and 1958, the situation was better than might have been anticipated, and it was thought that the partial introduction of parking meters in the Mayfair area, thereby enabling the side streets to be used to a greater extent, might perhaps have helped to ease congestion on this particular section of route, though it was not possible to investigate the matter further at that time.

The results obtained from the December 1959 survey showed a marked worsening in traffic congestion compared with any of the previous surveys,

TABLE I

AVERAGE BUS JOURNEY TIME AND BREAKDOWN INTO TIME IN MOTION AND STOPPED TIME
St. George's Hospital and Euston Station—All northbound and southbound journeys

	Sept./Oct. 1952 Mins.	May 1955 Mins.	Jan. 1957 Mins.	Nov. 1958 Mins.	Dec. 1959 Mins.	Jan. 1960 Mins.
Stopped time at						
Traffic lights and police controlled crossings	3.8	4.9	3.8	5.5	6.2	4.5
Pedestrian crossings*	0.4	0.6	0.1	0.1	0.3	0.3
Bus stops	2.1	2.2	2.5	1.9	2.4	2.1
Total Stopped Time (B)	6.3	7.6	6.5	7.5	8.9	6.9
Time in Motion (A-B)	13.0	12.9	12.3	12.7	13.2	12.1
Total Journey Time (A)	19.2	20.5	18.8	20.2	22.1	19.0

**Certain pedestrian crossings converted to police control since 1955*
(Small discrepancies in totals are due to rounding)

due to the longer delays and to a decrease in speed between stops. It is a fair conclusion that, but for the introduction of the 'Pink Zone' regulations, conditions in the area during the 1959 Christmas shopping period would have been chaotic, as indeed they were immediately outside the Zone. The period of the year is not one in which traffic density is at a maximum, and it is thought that the heavy congestion is to be attributed, at least in part, to uncontrolled pedestrian movements, and to an influx of private cars whose drivers may not be familiar with London; early darkness and inclement weather are other contributory factors.

The last survey, carried out in January 1960 at the time of the January sales, demonstrated that the 'Pink Zone' restrictions were in fact very effective under more normal conditions. It will be observed from the figures in the last column of Table I that, although total stopped time was somewhat greater than in January 1957, total journey time was only 0.2 minutes (12 seconds) longer, and mean speed between stops was if anything a little higher. The strict control on parking of vehicles, partial restriction on unloading and loading of trader's vans and special police supervision was therefore successful in allowing buses (and other traffic also) to run through the route from St. George's Hospital to Euston Station more easily than at any time since 1952, except for the period when fuel rationing was in force, though it would be an exaggeration to claim that conditions were equal to those of January 1957.

The data obtained from the last three of these surveys were analysed to show variations in average journey time at different periods of the day; the results are given in Table II.

TABLE II

VARIATIONS IN AVERAGE BUS JOURNEY TIME BY PERIODS OF DAY
St. George's Hospital & Euston Station—All northbound & southbound journeys

Time of Day	Nov. 1958 Mins.	Dec. 1959 Mins.	Jan. 1960 Mins.
8 a.m.-10 a.m.	17.5	19.4	17.3
10 a.m.- 1 p.m.	20.2	26.1	19.2
1 p.m.- 4 p.m.	21.3	20.0	19.6
4 p.m.- 6 p.m.	22.5	23.3	20.2

It will be seen that traffic congestion as measured by bus journey times is at a minimum during the morning period of peak travel to work, while with the exception of one period during the Christmas week of 1959, maximum congestion is encountered during the evening peak. Having regard to the location of this section of route, the growth of traffic congestion from 10.0 a.m. onwards is not perhaps surprising. The very marked increase in bus journey times during the 10.0 a.m. to 1.0 p.m. period in Christmas week 1959, and the equally marked reduction in the succeeding 1 p.m. to 4 p.m. period do, however, call for explanation. There can be little doubt that they are to be attributed to the 'Pink Zone' regulation which prohibited unloading and loading of vehicles after 1 p.m. Confirmation of this view, if needed, is afforded by a comparison between average journey times recorded in November 1958 and January 1960. In November 1958, the increase in the 1 p.m. to

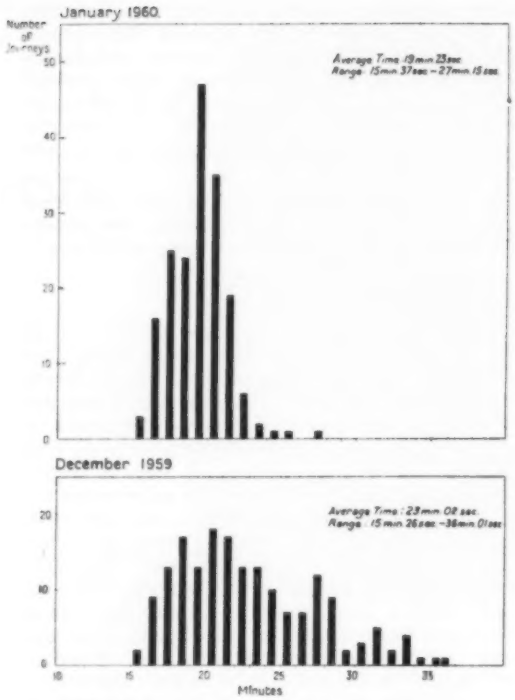

January 1960
Number of journeys
Average Time 19 min 23 sec
Range: 15 min 37 sec – 27 min 15 sec
December 1959
Average Time: 23 min 02 sec
Range: 15 min 26 sec – 36 min 01 sec
Minutes

Fig. 1. DISTRIBUTION OF BUS JOURNEY TIMES
St. George's Hospital to Euston Station Monday-Friday 10.00 a.m. to 4.00 p.m.

4 p.m. period, compared with the preceding three hours was 1.1 minutes, but only 0.4 minutes in January 1960.

Table II relates to average bus journey times, a presentation which conceals one of the most serious features of traffic congestion, namely the virtual impossibility of predicting how much time will be occupied in performing a given journey. Much data have been obtained in this connection in the course of our studies, but for continuity it is appropriate to quote again from the results of surveys on the busiest section of Route 14. Some figures are given in Table III. The distribution of journey times within the range for the 10.0 a.m. to 4.0 p.m. period during the week before Christmas 1959 and the first two weeks of January 1960 is shown in Fig. 1.

The data given in Table III below speak for themselves.

TABLE III

RANGE OF BUS JOURNEY TIMES BY PERIODS OF DAY
St. George's Hospital & Euston Station—All northbound & southbound journeys

Time of Day	Nov. 1958 Mins. Min. Max.	Dec. 1959 Mins. Min. Max.	Jan. 1960 Mins. Min. Max.
8 a.m.-10 a.m.	13.6 26.1 (17.5)	12.2 32.4 (19.4)	12.2 22.4 (17.3)
10 a.m.- 4 p.m.	15.1 29.8 (20.8)	15.4 36.0 (23.0)	15.6 27.3 (19.4)
4 p.m.- 6 p.m.	15.3 32.3 (22.5)	18.4 34.0 (23.3)	15.8 30.3 (20.2)

The figures in parenthesis are the mean journey times

On the section of route between Hyde Park Corner and Euston Station, especially during the more congested periods, buses can do little more than 'swim with the stream'. The journey can be performed in about 12 minutes but will often take nearly double that time, and in the most adverse conditions as long as 36 minutes; it is evident that in such circumstances the service is liable to become irregular throughout its length. This statement applies of course not only to Route 14 but to all others which pass through Central London.

The pattern of traffic flow from St. George's Hospital to Euston Station, though fairly typical for the West End, does not display the marked contrast between peak and off-peak travel that is familiar elsewhere. Other surveys have, however, provided information on this point and also on the abnormal congestion encountered on Monday mornings and Friday evenings, to which reference was made in the opening sentences of this contribution. Some striking figures arose out of a comprehensive survey in the vicinity of Putney Bridge during the third week of March 1959. Heavy congestion is encountered in both morning and evening peaks due very largely to private car traffic. The observations included journey times of buses on Route 74 between Lytton Grove (off Putney Hill) and the junction of Fulham High Street and Fulham Palace Road in the northbound direction, and between Edgarley Terrace (off Fulham Palace Road) and the Putney High Street/Upper Richmond Road intersection in the southbound direction, records being taken over the period 8.0 a.m. to 7.30 p.m. from Monday to Friday. The results are shown in Tables IV and V.

TABLE IV

AVERAGE BUS JOURNEY TIMES DURING MORNING PEAK AND MID-DAY PERIOD

Lytton Grove to Fulham Palace Road (northbound)

Monday		Tuesday to Friday	
Morning Peak 8.30-9 a.m. Mins.	Mid-day Period 12-2 p.m. Mins.	Morning Peak 8.30-9 a.m. Mins.	Mid-day Period 12-2 p.m. Mins.
14.9	6.3	10.5	5.9

It will be seen from Table IV that average bus journey time during the morning peak in the northbound direction was 4.4 minutes (42 per cent) longer on Monday than in the corresponding period on Tuesday, Wednesday, Thursday and Friday. Compared with the mid-day period journeys over this short section of route (1.1 miles) took on an average some $8\frac{1}{2}$ minutes longer on Monday and $4\frac{1}{2}$ minutes longer on the succeeding four days. In order to keep within their schedule buses must make up this time lost by faster running on other sections of the route with consequent increase in fuel consumption.

A similar pattern, though in reverse, was found for the southbound journeys (Table V) again involving a distance of only 1.1 miles. During the evening peak, which like the morning one is of comparatively short duration, average bus journey time on Friday was 7.2 minutes (74 per cent) longer than on the preceding four days. Compared with the early afternoon period, over $10\frac{1}{2}$ minutes was being lost on Friday, but only about $3\frac{1}{2}$ minutes on the four days Monday to Thursday.

TABLE V

AVERAGE BUS JOURNEY TIMES DURING EARLY AFTERNOON PERIOD AND EVENING PEAK

Edgarley Terrace to Upper Richmond Road (southbound)

Monday to Thursday		Friday	
Early Afternoon 2 p.m.-4 p.m. Mins.	Evening Peak 5.30-6 p.m. Mins.	Early Afternoon 2-4 p.m. Mins.	Evening Peak 5.30-6 p.m. Mins.
6.1	9.7	6.2	16.9

More recently an investigation was made to determine the effect of the 'tidal flow' traffic system in operation in Putney High Street. It was found that the system permits a smooth flow of traffic in the High Street itself but the adverse effects of the bottleneck intersections at both ends of Putney Bridge are still very apparent.

The effect of a diversion arising from road repairs in a particularly congested area is illustrated by a study carried out during July/August 1956, when for one week a section of Regent Street immediately north of Oxford Circus was completely closed to traffic. All vehicles were diverted along a one-way system so that the rectangle formed by Holles Street, Cavendish Square (south side), Margaret Street, Great Portland Street (south portion) and the connecting portion of Oxford Street comprised a roundabout, the streets within the area being closed to through traffic.

The diversion affected buses on some 20 routes, and observations were made during the week before and during the first of the two weeks that the diversion was in operation. The method adopted was to time buses at two points, one on the approach to Oxford Circus, and the other after leaving the Circus, the timing points being on a radius of about half a mile from the intersection itself. Observations were made over the period 8.0 a.m. to 6.30 p.m. on five days, Monday to Friday. From an analysis of data obtained it was possible to estimate the aggregate time lost by all buses, also the average time lost per bus as a consequence of the diversion. Conditions while the diversion was in operation varied considerably from day to day, being of course at their worst on the first day and again very bad on a day when there was heavy rain. On Friday, the last of the five days covered by the observations, there was relatively little congestion, this being no doubt due to the proximity of the August Bank Holiday. It was estimated that compared with the week prior to the diversion, the total time lost by buses amounted to 1,517 hours, the average time lost per bus being $3\frac{1}{2}$ hours over the five days. The effects of the diversion were apparent well outside the immediate area. During the week of the diversion 'lost miles due to traffic causes' were 10,800 greater than in the previous week and all but 500 were lost on routes passing through Oxford Circus.

The results of this survey are quoted mainly for the purpose of emphasizing the magnitude of the effect on public transport of a major road repair, but they also show that this particular example of one-way working and elimination of a right-turn at a major intersection was the reverse of beneficial. While

it may be conceded that well-chosen one-way systems may assist traffic flow, it must also be said that they are often viewed with misgivings by an operator of public service vehicles. Extra mileage is involved leading to an increase in consumption of fuel, and unless there is a clear saving in journey time, extra buses, with attendant crew costs, may have to be allocated to provide the same frequency of service. More important than all of these is the fact that passengers are diverted from points at which they wish to board or alight. This may not only lead to a loss of revenue, but there will be a tendency for public transport to be blamed for the inconvenience to which their passengers are being put, particularly in inclement weather.

Benefits of Major Improvements

An example of the benefits derived from a large-scale road improvement scheme is provided by results obtained from surveys in the vicinity of Hammersmith Broadway during a fortnight in October/November 1956 and again in September 1958. At the time of the earlier survey, work was already in progress on certain parts of the scheme, but the improvement affecting the Broadway itself had not been started. The second survey was carried out subsequent to the opening of the new Great West Road and the main roundabout at the Broadway, but before work had begun on the construction of pedestrian subways. Buses and trolleybuses on routes passing through the Broadway were timed at points sufficiently far removed from the intersection as to be unaffected by the reconstruction work, and it was possible therefore to use the same timing points in both surveys.

In order to make a comparison between the results of the two surveys which would be applicable to 'normal' traffic conditions, data obtained on those days of the 1956 survey which coincided with the Motor Show were eliminated. With this adjustment, traffic flow during the September 1958 survey was 30 per cent greater than in October/November 1956.

The effect of the road improvement scheme was considerable. No instances of severe congestion occurred during the period of the 1958 survey. In consequence, journey times longer than 10 minutes, which in 1956 formed 6 per cent of the total, were virtually eliminated. For buses operating northbound on Route 11, the reconstruction involved no increase in distance run between the timing points, and journey times were markedly reduced. Thus in October 1956, less than 35 per cent of the buses completed the timed distance in under five minutes; in September 1958 the proportion was as high as 86.5 per cent. In October 1956, 9.4 per cent of the buses took over 10 minutes for the journey between timing points and in a few instances more than 20 minutes. In September 1958, none took longer than 15 minutes. On the majority of routes, there was an increase in distance between the timing points but when traffic was at its greatest density, mean journey times were reduced by amounts varying between 16 and 29 per cent, according to the extra length of journey involved. In light traffic, such as is encountered after 7.15 p.m. on weekdays and during the whole of Sundays, buses on some routes had their journey times increased, but the number affected was small compared with other periods of the week and the overall effect of the reconstruction was clearly beneficial at that time. Some subsequent deterioration has been evident and is of course attributable to the major works still in progress.

A very recent study has been concerned with the effect of the introduction of parking meters in the whole of the Mayfair area as from April 4, 1960. For the purpose of this survey buses on Routes 25 and 32 were timed between Hyde Park Corner (Hamilton Place) and St. Giles Circus (via Piccadilly, Bond Street and Oxford Street). The portion of the route was divided into two sections, that from Hyde Park Corner to Oxford Circus being within the Parking Meter Zone, the other section from Oxford Circus to St. Giles Circus being outside the Zone. Observations were made on both northbound and southbound journeys during five days Monday to Friday immediately before the extension of the Parking Meter Zone, and again during another Monday to Friday period after the scheme had been in operation for three weeks.

Analysis of the data obtained for all journeys over the five days in the respective surveys showed that average bus journey time within the extended Parking Meter Zone was 8 per cent less than it was prior to April 4. There was also a reduction in average journey time outside the Zone amounting, however, to only 4 per cent. These reductions might have been due in part to the much drier weather encountered during the April survey, though regard must also be given to the increase of 6 per cent in traffic flow in Central London between the two periods. The net improvement apparent in the Parking Meter Zone was probably therefore a real one, but it was satisfying to provide some confirmatory evidence by analysing the data to show differences in journey times by period of the day. Some figures are given in Table VI.

TABLE VI

VARIATIONS IN AVERAGE BUS JOURNEY TIMES BY PERIODS OF DAY

Hyde Park Corner-Oxford Circus—All northbound and southbound journeys

Before and after extension of Mayfair Parking Meter Zone

Time of Day	Before extension	After extension	Reduction in journey time
	Mins.	Mins.	%
8 a.m.-10 a.m.	10.6	9.4	11
10 a.m.- 1 p.m.	14.4	13.7	5
1 p.m.- 4 p.m.	12.0	11.9	1
4 p.m.- 6 p.m.	12.2	10.0	18

It will be seen from this Table that the reductions in journey time resulting from the extended installation of parking meters were being obtained during the periods of peak travel to and from work rather than in the intervening hours. This finding could be explained by the virtual exclusion of all-day parkers; the more marked improvement during the evening peak being probably attributable to the fact that when the restrictions were less stringent departures of all-day parkers during the evening were at a more rapid rate than arrivals during the morning build-up.

The foregoing examples of information derived from traffic studies have shown on the one hand the adverse effects of congestion, and on the other the benefits that can be derived from various measures, including a major road improvement scheme, designed to alleviate conditions. Excluding the serious though transitory effects of road repairs, particularly in an area of dense traffic, the increased congestion which has been so marked a feature of the past eight years and more can fairly be attributed to the growth in the number of private cars on London streets. The extent of the growth is seen from a comparison of Metropolitan Police Census figures for 1952 and 1958 (the latest available). Between these years the average number of private cars counted per census point in Central London increased by 48 per cent, but vehicles other than private cars, and excluding pedal-cycles, increased by less than 4 per cent. The number of cars entering and leaving Central London has continued to increase since 1958, and it is unlikely that public transport can do very much to reverse this trend, if only for the reason that many of the cars are being used directly or indirectly for business purposes, in which travelling from and returning to home is included. The increase in the number of private cars has been accompanied by an increase in street parking. The elimination of the obstruction caused thereby would have an immediate beneficial effect, even though the number of vehicles in movement on the roads remained unchanged. Action on a small scale in a particular area tends merely to transfer the congestion elsewhere; but supposing that parking meters and other schemes for off-street parking, together with control of loading and unloading of vehicles, were introduced simultaneously throughout Central London, bus journey times might be reduced by some 4-5 per cent within that area.

Gains from Controlled Parking

It is confirmed by the survey relating to the extension of the Mayfair Parking Meter Zone which indicated a net reduction of 4 per cent in average journey time of buses passing through this Zone; and also by the fact that the journey time of buses between St. George's Hospital and Euston Station during January 1960 when the 'Pink Zone' was in operation was nearly 5 per cent less than in November 1958. Assuming that conditions outside the area (i.e. in the busier suburbs) remained unchanged, and that an overall reduction of $2\frac{1}{2}$ per cent were realized, this in turn might render it possible to maintain the scheduled services with some 130 fewer vehicles. The total operating and running costs of a double-deck bus vary over wide limits as between peak and off-peak, but for the purpose of this calculation can be taken as £5,500 per annum. (The figure includes crew costs, also costs of fuel, tyres, maintenance and depreciation). On this basis a freeing of the streets for moving traffic could effect an economy in the order of £700,000 per annum. This estimate is of course very conjectural; it is moreover difficult to conceive that widespread restrictions on street parking and loading and unloading of vehicles could be introduced on a given day. If, as is more likely, this desirable state of affairs were reached only over a period of years, the general growth of traffic in the meantime would necessitate a reassessment.

Little has been said so far about the effect of traffic congestion on running costs, the major item of which is fuel. The fuel consumption of buses operating to a schedule is much dependent on the number of stops per mile. On light suburban routes there are about four stops per mile and from six to 6.5 on busy routes; on a very arduous route stops per mile increase to about eight though up to thirteen may be encountered in isolated journeys. As a result of these variations in operating conditions, the mean fuel consumption of buses of the same type running on different routes ranges between the wide limits of 7.5 and 12 miles per gallon.

In compiling the schedules it is recognized that buses may have to stop for reasons other than picking up and setting down passengers, but the schedules can only cater for average conditions. The time lost due to stops not allowed for in a schedule has to be made up (if possible) by faster running between stops, i.e. by accelerating to a higher speed than would otherwise be necessary. This, of course, leads to an inevitable and more than linear increase in fuel consumption.

The effect on fuel consumption of an increase in the number of stops per mile was studied in the course of a comprehensive programme of tests carried out some years ago with buses running on the Motor Industry Research Association's Proving Ground near Nuneaton. Runs were made between two points maintaining a journey speed of 11 m.p.h. It was found that fuel consumption with four stops per mile was seven per cent greater than with two stops per mile (encountered on light routes in the Country area). With six stops per mile the increased consumption amounted to 32 per cent; for seven stops per mile, the increase compared with two stops per mile was as much as 65 per cent.

Conclusion

Although the application of traffic engineering principles in their widest context would substantially reduce and perhaps eliminate the increase in bus operating and running costs attributable to traffic congestion, it has already been indicated that there is no immediate practicable way in which this could be done to an extent such as might render it possible to reduce fares. The most that can be hoped is that timely action will be taken on a scale such as to arrest and perhaps start to reverse the rising trend in costs. It has been shown that fuel costs are markedly influenced by the frequency of stops and any measures which would reduce delays would be reflected in a saving in fuel, and also tyre and brake-liner costs. Without waiting for the benefits to be expected from major road improvements, the elimination, gradual though it might have to be, of all forms of street parking in busy thoroughfares would materially increase the flow of traffic. Minor improvements at bottleneck intersections would also help to reduce delays. The consequences for public transport would be not only a reduction in costs but the prospect of improved regularity which in turn would attract an increase in passenger revenue throughout the day.

Acknowledgment is made to the London Transport Executive for permission to use the data on which this article is based.

European Report

BERLIN'S URBAN MOTORWAY

By Dipl. Ing. Werner Leipold and Dipl. Ing. Herbert Liman.

Senate Administration for Building and Housing, Berlin.

Fig. 1. Berlin Ring Road: mouth of tunnel, entrance and exit ramps.

In the June issue of Traffic Engineering and Control the authors gave an example of the planning of a city road in the district of Spandau, Berlin. They here describe the major road network of Berlin with particular reference to the Ring Road under construction.

THE traffic situation of the city of Berlin with its 4,000,000 inhabitants cannot be compared with the problems of other cities in Germany. A city spread out over such a wide area, representing a homogeneous economic unit and an inter-connected residential organism, can only fulfil its functions if its traffic communications, especially for the constantly increasing motor car and lorry traffic, guarantee an efficient and time-saving movement of traffic. This makes it necessary to use modern road-building methods in order to overcome space and time in the best way as far as the development of means of communication is concerned.

In order to comply with these requirements the construction of a major road network has been envisaged. This network has the task of providing continuous and uninterrupted connections from the outskirts to the centre of the city as well as communications between the outer districts themselves; and by diverting regional and long-distance traffic it can relieve the city street network and, at the same time, increase its safety.

The inner Berlin Autobahn Ring (Berlin Ring Road) will have a diameter of approximately 10 to 12 km., and it will have no grade intersections and full control of access. It is to be supplemented by a system of four inter-connected tangents which border on the inner city (downtown) and also will have partial control of access. The present main arteries which traverse Berlin, as well as the Federal highways and autobahnen still to be completed, will either be intercepted at the Ring Road or diverted into the tangents. The total length of the network of the Ring Road and four tangents is approximately 100 km. without taking into account their connections with the trunk roads.

The siting of the Ring Road in Berlin resulted from the need to intercept the long-distance traffic and to divert traffic away from the inner, densely built-up city area, as well as to provide a safer and quicker flow of regional traffic into Berlin and its distribution within it. The Ring Road's proximity to the Berlin City Railway seemed especially appropriate because large industrial areas had developed alongside or close to it. These industrial areas, as well as the residential ones connected with them, generate a particularly heavy volume of passenger traffic comprising factory and office workers, and which in future will no longer be allowed to cross the inner city. Access to the future city, in which only 250,000 to 300,000 people will be working, will be by way of the four tangents which will surround the old city in an area of two and a half by three and a half kilometres. These city autobahns (urban motorways) differ in their fundamental design, principles of construction, profiles and supplementary features from the major streets as well as from the Federal Highways and autobahns. In a city every important road represents a fixed feature which according to height and position can hardly be changed and which needs to be connected to the City autobahn. Thus the position of the Ring Road has been fixed at seven metres below or six metres above the road area. It will have to run on stretches of varying length in cutting or on viaduct, and the important sections will be supported by engineering works such as supporting walls, steel bulkheads, new street bridges, etc. These expensive works, together with extensive work on the

subterranean public services, necessitate a considerably higher expenditure than is required for motorways in non-built-up areas.

Preliminary estimates for the building of the Ring Road and the four tangents amount to approximately DM. 1.3 milliard for construction work alone.

The first section of the construction of the Ring Road, approximately two kilometres in length, was completed on November 26, 1958, after 32 months, and the cost was approximately DM. 34 million. The city road which emerged from underneath the railway bridges was widened. In this widening lies the beginning of the first section of the construction of the Ring Road which runs under the Kurfurstendamm in a tunnel 220 metres long. It comes up to the city railway with a counter curve on a 7-9 m. deep cutting with which it runs parallel for a long distance. A part of the city railway area was used and during construction, in order to construct a residential road beside it, it was necessary to erect a seven metre high supporting wall. This section finishes at the beginning of the ramps for connecting it with the city intersections. The continuation of this first section was handed over and opened to traffic in September of this year on the occasion of the Street Building Meeting.

After running underneath the city road (Hohenzollerndamm) the Ring Road at first runs parallel with the city railway area for a short distance and will run over it on an S shaped curved bridge for a distance of 230 m. in order to be connected, for the time being, to the existing street network.

Work began in January 1958 on a section approximately 4.2 km. long, running in a northerly direction to connect the existing section from Halenseestrasse to Charlottenburg Nord/Siemensplatz, which at present is intended to terminate at the Siemensdamm. North of the railway bridges, the Avus as well as the city roads are connected to the City autobahn without any grade crossings and continue northwards in a curve with a minimum radius of 250 m. Its eastern carriageway crosses the city railway by a bridge sloping to approximately 40° and then slopes to the level of the railway in the same way as the western carriageway. By making use of the city railway terrain, and by building supporting walls, the Ring Road runs underneath three city roads which run in an East-West direction. By locating the Ring Road both sides of the railway, it is easier to connect it to the city roads and ramps. North of the third city road both carriageways ascend. The eastern carriageway runs over the railway by a bridge which inclines approximately 30° and is 250 m. long. Both of the carriageways of the Ring Road, now running parallel to each other, underpass a city road running in an East-West direction and ascend in a ramp to the so-called North-West Viaduct. This bridge ascends over the railway tracks, the Spree and a projected new lock, for the length of 876 m., in order to be temporarily connected to the already existing road network near the Siemensplatz.

The bridge consists of six double-body frames supported on a hemmed-in centre span and lateral suspension supports. The individual span widths range from 67-85 m. The double body frames were constructed by symmetrical progressive assembly of the crossbars. On reaching half the width of the spans the cantilever movements were reduced by relieving

Fig. 2. Second section of the Ring Road, showing bridge over the railway still under construction.

the tension by means of tensioning devices over a steel pylon erected on the centre pier. In cross-section the bridge consists of four caissons of a constructional height of three m. and lateral base plates. The bridge is 29 m. wide and has a crossfall of 2.5 per cent. The plan view shows a curvature with radii of 650 m., 2,000 m. and 750 m. with intermittent clotoides. The longitudinal fall amounts to 0.5 per cent constant.

This section of the Berlin Autobahn Ring, approximately between Avus in the South and Siemensplatz in the North, is for the purpose of relieving the centre of the city North-South connections, which, because of the railway and Spree bridges, consist for the most part of five roads, of which three fall within the influence of the sphere of this section, whereas the other two fall within the sphere of the Western tangent. By traffic counts, and by personal interview at three North-South junctions, it was possible to ascertain the origin and destination of the traffic and its volume. Thus a table giving the traffic ratios as between 42 districts of origin and destination was ascertained. In accordance with the time-table for the planned and the existing network the flow of traffic in the lead at the time was transferred. This resulted, as was to be expected, in a volume of 850 motor vehicles per hour in one direction on this section of the Ring Road in 1958. This volume of traffic will increase with the expected motorized traffic (for a motoring ratio of 1:5) to about 2,500 motor vehicles per hour. The decrease to be expected in the future on the North-South roads running nearly parallel, will be approximately 40 to 50 per cent. It was also possible to give exact figures for the junctions of the Ring Road with the urban roads. This examination confirms the conclusions previously arrived at, that at this point of the Autobahn Ring it would be necessary also to have three-lane dual carriageways which at peak hours would be able to take a maximum of approximately 3,500-3,600 passenger vehicles per hour in each direction. For construction of the ramps

and distances between intersections with the city roads, it is essential that there are two entrance ramps and two exit ramps, and if the City Autobahn is built with three lanes, on an average at each of these junctions up to 900 passenger vehicles per hour can be diverted, that is to say can leave in each direction. It should be mentioned here that when the construction of urban motorways is planned, the intersections present the greatest difficulties, because if there are no efficient junction points, an urban motorway cannot provide traffic relief. Also, any time saved on it will be useless if these intersections have not been built advantageously. Junctions which necessitate long detours will frighten away some of the potential users of urban motorways, if the saving in time and running costs are absorbed by these longer routes. The motorways will be made use of by the driver more frequently if he is able to reach his goal quicker and easier than by way of the narrow meshed system of city roads.

Principles of Construction

The principles of construction were based on the design speed of traffic of 80 km./h. It does not follow that there will be a speed limit. But the traffic rules of the Federal autobahns apply: Only motor vehicles of specified construction can exceed 40 km./h., no turns are permitted, parking is prohibited. Both carriageways have three lanes, each 3.5 m. wide and are separated from each other by a central reserve 2 m. wide. On both sides of the dual carriageway additional shoulders of a minimum width of 2 m. are built. They are raised 8 cm. above the carriageway are paved with flags, and the rolled kerb serves as a drainage gutter. They may not be used for parking, but only in emergency for breakdowns. The longitudinal fall of the main carriageway is limited to three per cent for the fast roads and five per cent for the junction ramps, of which four per cent is the desired incline. In especially difficult cases the fall of the descending ramp may be increased to six per cent, the drop in curves amounts to the maximum of six per cent and the rounding-off of change of gradient should be on the main roads as high as possible. The position and technical construction of the intersections are important for the capacity at the multigrade intersections and especially for the relief which they can bring to the city street network. The average distance between them amounts to approximately one to one-and-a-half kilometres, but it depends of course on the network of the adjoining main roads, and the distances between intersections will therefore be less in the centre of the town than in the outlying districts.

Fig. 3. Entrance to tunnel beneath the Rathenau place.

Fig. 4. Mouth of tunnel showing express bus stops, with stairway entrances and exits.

As the points of junctions are so close together the traffic of the exit and entrance almost merge together. For this reason alone, urban motorways should have three-lane dual carriageways of which the outside right-hand lane (left-hand in Britain) is allocated to interchange traffic flowing into the main traffic lanes, taking the place of the traffic which is leaving it. At the points where the acceleration and deceleration lanes lie very close together it is better to build a fourth lane for the merging traffic. In principle, it may be said that in special circumstances one can eliminate deceleration lanes in densely built-up city areas, but acceleration lanes should always be built.

Supplementary features

Contrary to the Federal Autobahnen, the urban motorways are provided with public lighting. The lighting pylons, which have been especially developed for this purpose with dual brackets, are placed on the central reserve and each lamp is provided with three fluorescent lamps of 65 W. each. The candle-power is 16-20 Lux, whereby, because of the minimum distance of approximately 30 m. and a focus height of 10 m., an even illumination is guaranteed. At night, candle-power of the tunnel is also 20 Lux, but during the daytime it is photo-electrically adjusted to daylight. It can therefore amount to 1,000 Lux at the entrance to the tunnels and decrease to 200 Lux towards the exits. The eye therefore becomes quickly adapted to light differences and it is unnecessary to switch on the headlights when driving through the tunnels. Moreover, the walls of the tunnels are covered with unpolished white tiles, in order to improve the lighting, and the ceiling of the tunnel is painted yellowish-white.

Furthermore, unlike the Federal autobahns, on the Berlin Ring Road an express bus service has been provided for. The stops for the buses are placed in special stop bays, covered with a concrete top. A covered staircase provides for changing between the motorway and city street (Fig. 4), in which space has been left for the installation of escalators at a later date.

The central reserve is provided on both sides with steel barriers according to the Armcoflex system, as are also the outsides of curves and special danger points, for instance, bridges, embankments, etc. These barriers, painted white, contribute to a large extent to the optical guidance of traffic, to which further white-painted kerbs and road markings in the form of ground reflectors contribute. These latter are fitted between each paint strip. All important traffic signs on the Autobahn Ring and in the vicinity of the intersections are lighted, whereby, contrary to the present system on the Federal autobahns, the traffic signs are placed over the traffic lanes, so that over each lane the distant and near point as well as the next exit is indicated. Directional arrows are marked on the carriageways and ramps for information and automatic signal installations at the points of junction of city roads complete the equipment.

Different from the Ring Road, the tangents cannot be built everywhere without crossings at the same level. Existing building above and below ground prevents this. Therefore, the North tangent runs at the level in a section of street which for a long time to come can cope with all traffic requirements. A start has been made with the building of part of the South tangent which also still has crossings at the same level. The essential sections of the tangents also will have dual carriageways with three lanes each. (Fig. 5). That part of the South tangent which can be seen in the illustration will, in future, be continued as an elevated highway. Work on the first part of the southern end of the West tangent will start shortly.

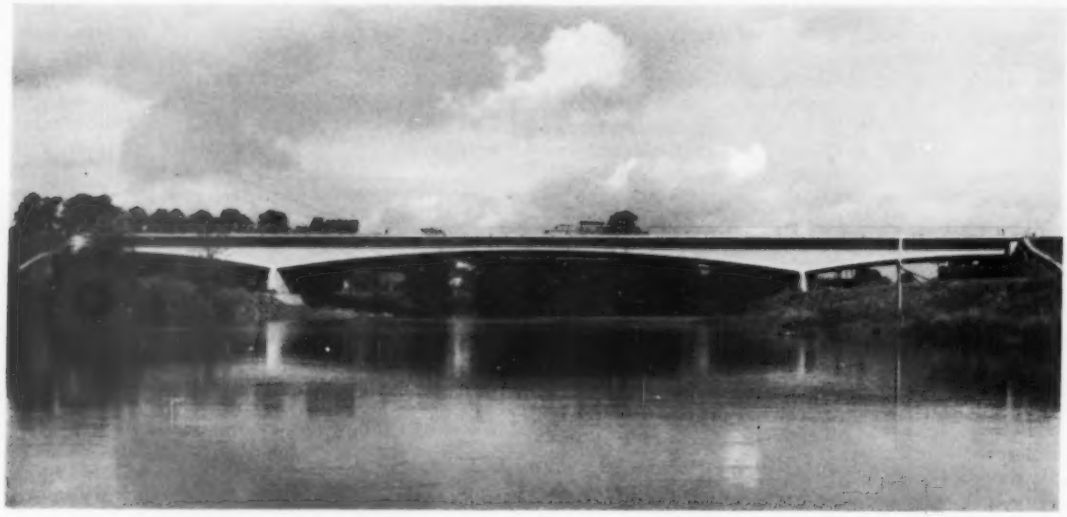
In future, the most heavily used sections of the tangents in the whole of Berlin will probably be those sections which lie close to the city, and form a 'tangent square'. It is not possible at the moment, however, to obtain information in this respect by making a traffic survey, because the city is divided into two sections.

Such prognoses as have been possible, however, form the basis for the first designs of the route of the tangent square, and the most economical solution for intersections has so far been found to be the construction of four-level crossings similar to those already built in Los Angeles. The plans for the whole of the tangent network are, however, not yet complete, but work on them is being actively pursued.

It is anticipated in Germany that within the next ten years the present passenger traffic will be doubled. The difficulties which will arise because of this volume of passenger traffic are without doubt much higher if a smooth flow of traffic is to be maintained. We know that at the traffic congestion points, namely in towns, the traffic chaos cannot be stemmed, as is already happening in some districts, if not in time, that is to say immediately, the street network of our towns is not planned anew and rebuilt. Much of the future planning of some of our cities may today seem revolutionary, if not utopian. It is necessary to throw overboard much that has been accepted so far and to build anew, in order to guarantee the safest, easiest and most economical flow of traffic. In this respect, Berlin is trying to create for the future an adequate street system capable of dealing with traffic.

Acknowledgment is made to the Government Photographic Department, Berlin, for permission to reproduce the illustrations used in this article.

Fig. 5. Completed section of the South Tangent.



Above. A view of the new Bridstow Bridge which carries the Ross Motorway across the River Wye.

PROJECTS AND AC

IN PICTU

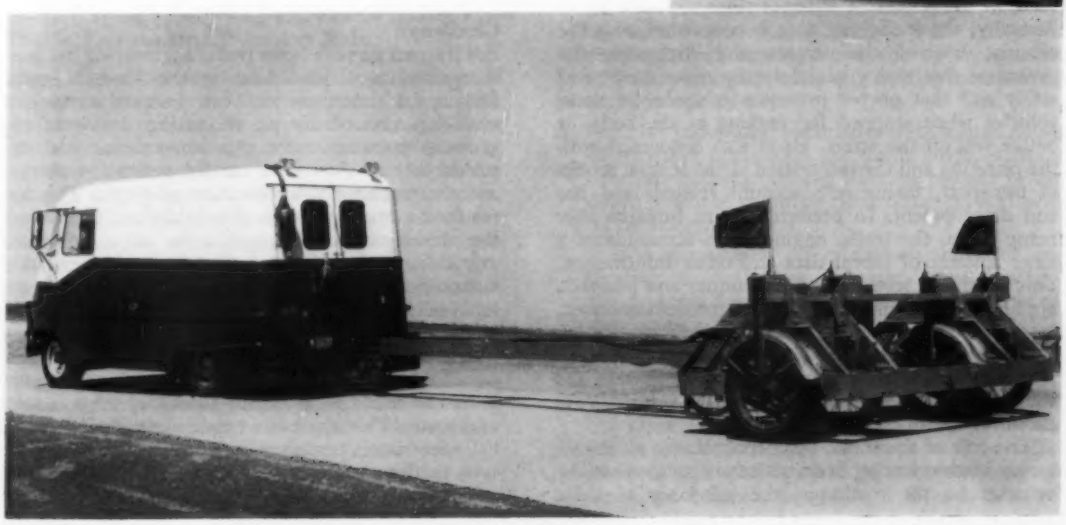
The giant sign in the photograph on the left has recently been erected on the Stretford-Eccles By-Pass. The large floodlights below this sign are worth noting. (Below) A view showing part of the construction in progress on the Doncaster Motorway, described more fully on page 352.

Above. This picture of the Bridstow Bridge shows clearly the flood relief arches on the left.

ANDACHIEVEMENTS

PICTURES

The photograph on the right is of the Long Limb extension ladder, exhibited at the A.P.L.E. Conference at Folkestone, while below is one of the measuring instruments in use on the AASHO testing track near Chicago, U.S.A. A full description of these tests is given on page 340.



American View of Traffic Engineering

by EDWARD G. WETZEL

Past President of the Institute of Traffic Engineers

THE science of traffic engineering was practised even before it was named—in fact, we might consider that the regulations and control, whether by physical or mechanical means, for the movement of people and goods, was perhaps the origin. However, more realistically, this field of science was born with the era of the rubber-tired vehicle and came to be so recognized with the growing operational problems of highway transportation. From the earlier years, when traffic operations were controlled by signs, signals and pavement markings, traffic engineering has expanded into a much broader field of transport operations and public service. Largely through the resourceful use and application of workable techniques and sound engineering practices to accommodate increasing traffic on facilities that were becoming obsolete with congestion, traffic engineering is assuming an increasingly important function in the transportation picture.

To gain a perspective, let us consider what has been done in the field of traffic engineering, and what the future portends with growing population, increasing use of motor vehicles, and increasing miles of surfaced highways.

Role of the Traffic Engineer

Basically, the traffic engineer is concerned with the efficient use of the streets and highways—the assurance that motor vehicles may move freely and safely and that proper provision is made for these vehicles when stopped for parking at the kerb, or better yet, off the street. He is also concerned with the planning and the integration of the several modes of transport, taking into account related land use and development. In performing this function over many years, the traffic engineer has accumulated a large amount of useful data and other information, developed and tested many techniques and analyses, applied sound engineering practice and demonstrated, by many successful and resourceful solutions, that his experience is most valuable and necessary for the proper planning of adequate streets and highways and the safe and expeditious movement of vehicles over them.

The role of the traffic engineer includes all engineering matters having to do with the operations of the vehicles on the roadways, the adequacy of these roadways, and the provision for off-street parking and terminal facilities. More specifically, such matters involve the following:

(1) Geometric highway design—the geometry of roadways and intersections to provide ample safe vehicle capacity of the carriageways, (2) road surface characteristics affecting traffic, (3) parking, loading and unloading terminals—their location, design and operations, (4) means and methods for securing efficient highway transportation, including accident prevention and public education, (5) vehicle characteristics and performance, (6) traffic capacity, speed, composition and other characteristics of the traffic stream, (7) driver characteristics and driver behaviour, (8) methods of regulation and control of both vehicular and pedestrian traffic, (9) use and relationship of the municipal street and highway transport system to other transport facilities and to area and land use planning, (10) economics of the highways and their use.

Certainly the knowledge gained from these traffic engineering activities can provide a broad base for dealing with problems that lie ahead as more vehicles and increasing mileage of road come into use. Many of the foreseeable problems that may be expected will certainly tax the ingenuity of the highway administrator and traffic engineer in the application of proven techniques and ability to resolve the traffic operational problems.

Challenge

For the past three decades traffic engineering has been recognized as a profession in the United States. During this time there has been observed a transport evolution created by an increasing desire of the growing population for the convenience and dependability of the motor car for personal transport and the truck for the movement of goods. This has resulted in the expansion of industry and commerce, the development of larger areas of concentrated population, increasing travel and many other social and economic changes. Unfortunately, highway needs have failed to keep pace with the increasing traffic, and general improvement in economic development. The traffic engineer, nevertheless, had to do the best he could to obtain maximum operating efficiency with the facilities available—many obsolete streets and roads. This alone is a tremendous challenge and calls for sound engineering judgment to keep pace with modern, social, economic and physical advances of transport progress.

Changing Travel Patterns

Traffic engineers are well aware that the major or primary highways, with or without controlled access, cannot be expected to handle all the increasing volume of traffic anticipated in the foreseeable future. These major highways are primarily for the longer journeys—which, in the end, are only a part of the total vehicular travel on the city streets and rural roads. The greater concentration of travel will be in the cities and surrounding communities. This travel will be made up largely of shorter trips in many directions. Facilities to accommodate this travel, whether it be home-to-work, social or recreational travel, must have flexibility to serve dispersed communities as well as the areas of business concentration. The location and alignment of these streets and highways will undoubtedly call for a departure from the traditional system of streets and highways which normally fan out from the central area, as spokes from the hub of a wheel. It will be necessary to consider circumferential, peripheral and interconnecting streets and highways to satisfy the needs of the concentrations of population and industry.

Traffic engineering is a basic tool for determining the location and alignment of the major arteries, and the capacities that should be provided on these routes, the crossroads and adjacent streets, to assure a fluid interchange of traffic. Adequate forecasts of future traffic will be necessary to give assurance that the capacity needs will be known and ultimately provided for.

However, existing streets and highways must be made to operate more efficiently and safely if they are to continue to serve the growing volume of vehicle-miles of travel. Traffic engineering studies can reveal changing travel patterns, the volumes and travel speeds of the traffic, the need for and location of traffic signs and signals and the location and design of channelization at intersections. Experience has shown that implementing the results of such studies does improve the level of traffic service on the existing streets, by reducing congestion and accidents and providing for more correct and positive traffic regulations and control measures.

Traffic Engineering Planning Role

There is an increasing trend toward a recognition of the traffic engineer's important role in transport planning and terminal facilities and related land use in communities and larger areas of concentration of population and business. The very nature of his training, knowledge and experience makes the traffic engineer a valuable and essential member of the transport team of administrators, engineers and planners. More and more cities of all sizes are recognizing the need for a comprehensive transport plan, that can be integrated with the growing development of the cities and surrounding areas. Industry, business and the general economic welfare of the people is inextricably tied to transport. Traffic engineers are increasingly developing a closer working relationship with planners and together have a major role in the public interest to see that needs for adequate transport facilities are recognized and provided through appropriate government agencies.

Relation to Administration-Management

In recent years in the United States, and also in several European countries, the traffic engineer has assumed a more important position in the administration and management responsible for transport facilities and their operation. His knowledge of and experience with the characteristics of changing patterns of travel and traffic behaviour, the effect of the various vehicle characteristics on the traffic flow, and the capacity of the carriageways or lanes, and the criteria for proper design of the road, especially at intersections, provides the fundamental information and data necessary for improving existing streets and highways and providing new facilities.

With a correct position in the administrative organization, the traffic engineer can assume the functions for which he is qualified. For example: the collection and analysis of data to evaluate the deficiencies of existing facilities and the needs and priorities for improvements, is a proper function of the traffic engineer. Similarly, his knowledge of the driver and vehicle characteristics and the traffic volumes anticipated will permit the development of suitable standards and design criteria for construction plans. Since the traffic engineer's primary concern has been with traffic operations—the regulation and control of vehicles on the streets and highways, he is extremely knowledgeable on the proper design of the facilities to avoid traffic congestion and accident hazards.

As new highways are built and new frontiers opened to commerce and social and recreational travel, engineers engaged in the field of traffic engineering will find expanding opportunities to apply their knowledge and techniques toward maximum operating efficiency and safety of the streets and highways for the benefit of the highway user.

Conclusions

1. Traffic engineering, as defined by the Institute of Traffic Engineers of the United States, is that phase of engineering which deals with the planning and geometric design of streets, highways and abutting lands, and with traffic operation thereon, as their use is related to the safe, convenient and economic transport of persons and goods. The use of this technical knowledge has contributed to increased operating efficiency and safety of existing streets and highways, and the recognition of the importance of traffic engineering to improved highway operations.
2. With his knowledge, experience and understanding of transport operations, the traffic engineer has a close working relationship with the planner in the development of comprehensive transport and land use development plans.
3. Traffic engineering offers opportunities for increasing responsibilities in transport, administration and management, for the economic benefit of the communities and highway user.
4. Much knowledge and experience has been acquired and used most successfully by traffic engineers in the United States and several European countries, to resolve many transport problems. A continuous exchange of this traffic engineering knowledge and experience among all concerned is highly desirable.

AMERICAN REPORT

AASHO ROAD TEST

Fig. 1. Aerial view of AASHO road test.

THE most comprehensive road test ever conducted is nearing completion at Ottawa, Illinois. For the last two years, for 19 hours a day for six days a week, trucks carrying varying weights have been running over six separated sections of a four-lane divided highway at 35 m.p.h. At the wheels of the vehicles are army drivers working in nine and a half hour shifts with five breaks, which get closer together as the shift progresses. The purpose of the exercise, sponsored by the American Association of Highway Officials and administered and directed by the Highway Research Board, is the testing of road surfaces with the object of finding formulae for road construction to meet given requirements. It is largely a question of trial and error of varying types of road construction to see how they stand up to such continuous wear under certain conditions. As the sections give way they are taken out of service, as there is no maintenance. To date those sections still in service have been subjected to some 950,000 applications on an average, that is the axles have been driven over the surface that number of times, and the test mileage to date is some 14½ million.

Both rigid and flexible types of construction are being tested and those responsible for the test are emphatic that the purpose is not to make comparisons between one type of construction or material and another, as, although certain conclusions will inevitably be reached and it will be possible to compare certain sections in reaching final conclusions, other matters have to be taken into account, including costs. The fact that there is no maintenance cost to be calculated is a very relevant factor.

Nonetheless, it is understandable that considerable and continuous interest is being taken by the associations concerned with types of material, and it is difficult to prevent premature conclusions being reached. It must be repeated, however, that the importance of the project is not to ascertain which is the best material or the best form of construction, but how those under test behave in certain conditions, so as to ascertain what specification can be made for given conditions. It is hoped that by obtaining such a formula the optimum return could be obtained from road construction for the expenditure involved.

The information which is being measured or observed includes for instance, in the case of rigid surfaces, such matters as faults at joints, faults and length, the cracks and type of cracks and longitudinal profile. Transient movements are also measured, as these are often the forerunner of damage, equally the downward movement of the pavement caused by the vehicle is observed as well as the sharpness of the bend caused by the vehicle and the upward and downward movements of the surface caused by temperature variations.

To carry out the observations a number of high precision instruments have been designed with a view to serving two purposes. The first is to assist in the measurement of the various effects of traffic on the test sections and in the measurement of variations in environmental conditions such as soil moisture content and sub-surface temperature at the test site. The second is to accelerate the acquisition and reduction of test data to summary form to permit rapid engineering and statistical analysis. Automatic data reduction not only makes possible analyses that would be inordinately cumbersome and time-consuming by conventional techniques, but it also reduces human reading and transcription errors to a minimum.

Many other observations involve devices that change the measured phenomena into electric potential. They have several advantages over gauges of the mechanical type, foremost of which are:

(1) they are able to detect extremely small changes (high sensitivity); (2) they can be placed under the pavement or in other inaccessible places; (3) they can be used with highly efficient automatic recording techniques, and (4) they permit observations of phenomena that take place too fast for visual observation.

An electro-mechanical device has been developed that will in effect 'plot' the profile of the road surface at a rate of about five miles per hour. This is an extremely important device since the relative roughness of a road surface is one of the best indications

of its adequacy as a high quality road. Furthermore, changes in profile of a given surface over a period may indicate its probable future behaviour.

Another important measurement involves the degree to which a pavement is 'bent' under a moving load. The more sharply the surfacing material is bent the sooner it will fail, other things being equal. Automatic equipment has been developed to measure this phenomenon under traffic operating over a wide range of speeds. Electronic and mechanical equipment is used to measure strains and deflections in the pavements and bridges, to determine moisture content, temperature and frost penetration, and to determine the density of paving materials during and after construction. The density device involves an interesting application of nuclear physics in which the fact that the attenuation of gamma radiation increases with a rise in density is used as the basis for a non-destructive test technique. Other devices indicate sub-surface pressures, slab sub-base contact, vehicle position and many other related variables.

Table 1 shows the types of construction for both the rigid and flexible pavements and the axle-loadings to which they are being subjected. The straight sections of the loops contain 836 separate test sections, representing nearly 200 different combinations of various thickness of surfacing, base and sub-base material. Half of each test loop is constructed with portland cement concrete and half with an asphalt concrete.

Fig. 2. Above. Traffic in operation with tractor-semi-trailers carrying 22,400 lb. on single axles and 40,000 lb. on tandem axles. The smaller trucks are carrying 2,000 and 6,000 lb. on single axles.

Fig. 3. Below. Vehicle crossing test bridge span, one of 16 spans.

TABLE 1

	LOOP 3(A)	LOOP 6(D)	LOOP 5(C)	LOOP 2(E)	LOOP 1(F)	LOOP 4(B)
Test axle loadings:	12,000-lb. single 24,000-lb. tandem	30,000-lb. single 48,000-lb. tandem	22,400-lb. single 40,000-lb. tandem	2,000-lb. single 6,000-lb. single	No traffic Strain test traffic	18,000-lb. single 32,000-lb. tandem
Rigid Pavements						
No. of test sections	68	68	68	40	56	68
Concrete slab thicknesses	3.5, 5.0, 6.5, 8.0	8.0, 9.5, 11.0, 12.5	6.5, 8.0, 9.5, 11.0	2.5, 3.5, 5.0	2.5, 5.0, 9.5, 12.5	5.0, 6.5, 8.0, 9.5
Sub-base thicknesses	0, 3, 6, 9	0, 3, 6, 9	0, 3, 6, 9,	0, 3, 6	0, 6	0, 3, 6, 9
All slab thicknesses occur as both reinforced and plain pavement.						
Flexible Pavements						
No. of test sections	84	84	84	68	64	84
Asphalt Concrete Surfacing thicknesses	2, 3, 4	4, 5, 6	3, 4, 5	0*, 1, 2, 3	1, 3, 5	3, 4, 5
Base thicknesses	0, 3, 6	3, 6, 9	3, 6, 9	0, 3, 6	0, 6	0, 3, 6
Sub-base thicknesses	0, 4, 8	8, 12, 16	4, 8, 12	0, 4	0, 8, 16	4, 8, 12

Special sections to study effects of paved shoulders, base type, etc., are not shown. **Surface treatment.*

Special attention has been given to design levels and the AASHO Road Test is the first such project to employ a scientific method of experiment design. Two important features of this method were followed. These are randomization, which assures unbiased findings, and replication (repeating), which allows determination of the reliability of the findings.

Another important feature is the use of complete factorial experiment designs in which every level of each factor occurs in combination with every level of all other factors. For example, if a test loop has rigid slab thickness levels of 8.0, 9.5, 11.0 and 12.5 inches, while sub-base thickness levels are 3, 6 and 9 inches, there must be 12 combinations (4 x 3) to produce a complete factorial experiment. If a third design factor is added, such as slab reinforcement, there must be 24 combinations, since each level of slab thickness will occur as reinforced and non-reinforced.

Throughout the AASHO Road Test facility, slab thickness levels of the rigid sections are 2.5, 3.5, 5.0, 6.5, 8.0, 9.5, 11.0 and 12.5 inches. Sub-base thicknesses are 0, 3, 6 and 9 inches. In the flexible sections, levels of surfacing thickness are zero (surface treatment), 1, 2, 3, 4, 5 and 6 inches. Levels of base thickness are 0, 3, 6 and 9 inches, while sub-base is 0, 4, 8, 12 or 16 inches.

The lightest and heaviest combinations, of course, are not typical of current design practice. However, these under-designed and over-designed sections are necessary in order to establish upper and lower limits on the performance versus thickness curve, which is one major objective of the experiment.

The axle loads applied to the test pavements also vary widely. Single axle loads range from 2,000 through 6,000—12,000—18,000—22,400 and 30,000 pounds. Tandem axle loads are 24,000—32,000—40,000 and 48,000 pounds. In each case, the upper limits are above those allowed by vehicle weight laws throughout the states.

The vehicles operate at a speed of 35 miles per hour on the straight sections and 25 m.p.h. on the turns. The 35 m.p.h. speed was chosen since deflections in pavements do not change significantly at higher speeds. Generally speaking, the lightest pavements are tested under the lightest loads, and the heaviest pavements under the heaviest loads. However, in any one loop, thickness levels range from relatively-light to relatively-heavy for the axle loads assigned to that particular loop. Moreover, there is an overlapping of thickness levels between loops so that identical pavements are subjected to different axle loads.

In addition to the surfaces under test there are 16 test bridge spans, which carry the heaviest single and tandem loads. Each 50-foot span is one lane wide and is composed of three simple beams and a reinforced concrete slab. Eight bridges have steel beams, four have conventional reinforced concrete, and four have pre-stressed concrete, with two of these being pre-tensioned and two post-tensioned.

The bridge studies have two principal objectives: (1) To determine the behaviour of short-span highway bridges under repeated applications of overstress; (2) To determine the dynamic effects of moving vehicles on short-span highway bridges. All test bridges are subjected to the normal test traffic to provide data necessary to attain the first objective. The second objective requires special runs of vehicles of varying weights at different speeds. Measurements on the bridges will be primarily deflections and strain, both transient and cumulative. In practice, the bridges were under-designed with a view to testing them to the point of no return. Here again, the purpose was not to ascertain comparisons, as they were not constructed on the same basis.

The whole test, which was this year extended to November 30, 1960, will have cost some $26 million (£9 million) and the team engaged on it will then prepare a number of reports for wide dissemination among those concerned with road construction.

A number of subsidiary observations are being made by interested parties, including the various trade associations. The whole test is sponsored by the American Association of State Highway Officials, administered and directed by the Highway Research Board and by the National Academy of Sciences of the National Research Council and is being financed by the States, Government departments and trade associations.

Its official objectives can be summarized as:

(1) To determine the significant relationships between the number of repetitions of specified axle loads of different magnitude and arrangement and the performance of different thicknesses of uniformly designed and constructed asphaltic concrete, plain Portland Cement concrete, and reinforced Portland Cement concrete on different thicknesses of bases and sub-bases when on a basement soil of known characteristics.
(2) To determine the significant effects of specified vehicle axle loads and gross vehicle loads when applied at known frequency on bridges of known design and characteristics.
(3) To make special studies dealing with such subjects as paved shoulders, base types, pavement fatigue, tyre size and pressures, and heavy military vehicles, and to correlate the findings of these special studies with the results of the basic research.
(4) To provide a record of the type and extent of effort and materials required to keep each of the test sections or portions thereof in a satisfactory condition until discontinued for test purposes.
(5) To develop instrumentation, test procedures, data, charts, graphs, and formulae, which will reflect the capabilities of the various test sections; and which will be helpful in future highway design, in the evaluation of the load-carrying capabilities of existing roads and in determining the most promising areas for further road research.

next month's contributors include:

Conspicuity of White and Coloured Signs in Rural Surroundings
P. Odescalchi
Road Research Laboratory

Introduction to Traffic Studies *J. T. Duff*
Senior Engineer, Ministry of Transport

Peak Hour Controls on Motorways
Richard J. Carlson
Traffic Engineering Division, Seattle, Washington

Economic Aspect of Road Safety
Claude Abraham and J. Thedie
Ministry of Public Works and Transport, Paris

Studies in Visibility and Accidents
J. M. Waldram, Research Laboratories, G.E.C.

American Report
Burton W. Marsh and William L. Carson
Traffic Engineering Department, American Automobile Association

Instruments for Traffic Engineers 3
Speed
F. D. Hobbs
Paviors Lecturer in Highway and Traffic Engineering, Birmingham University

special reports on:

Road Safety Research 1959

Institution of Municipal Engineers Car Parking Conference

Fifth International Traffic Study Week, International Road Safety Conference

ROAD SAFETY

SPEED LIMITS
ITALIAN EXPERIENCE

by Cesare Biffi

TO ask for the results of the experiments made in Italy with regard to speed limits on the road is to ask something about which we do not know enough ourselves. In fact, we are actually only beginning to apply the regulations of our new Highway Code which, as from July 1, 1959, established a maximum speed of 50 km. per hour in built-up areas, with the possibility of putting this speed limit up or down in particular cases, and gives the option of applying speed limits even outside built-up areas. This new code also establishes maximum speeds for specified vehicles such as buses and lorries. However, even if conclusive statistical results cannot be produced, some observations on first experiences in this connection may be of interest.

In December 1959, and in the first two months of 1960, a semi-official poll was conducted to find out the number of speed offences. A check was carried out on 4,054 vehicles and 524, or 12.9 per cent, violated the limit speed of 50 km. per hour. Of these 2.6 per cent were not exceeding 55 km. per hour, 9.1 per cent were going between 55 and 70 km. per hour, and 1.2 per cent were exceeding 70 km. per hour.

These figures do not reveal much, but they give some encouragement that there is no need for despair and that it can be hoped that road offences can be reduced to reasonable proportions once a constant check is established, even if, for the time being, controls are too desultory to produce positive results.

In Lombardy in Northern Italy, which has nearly one-fifth of the motor cars existing in the whole of Italy, the metropolitan police have intervened and have given the following statistics of speed limit in fractions:

YEAR	1959		1960
Quarter	July—Aug—Sept	Oct—Nov—Dec	Jan—Feb—March
Speed offences	5,279	3,880	5,633

It would seem from these figures that the new speed limits had at first a 'deterrent' effect, which, however, was soon followed by a resumption of indiscipline in the first quarter of this year. But this can be accounted for, at least partly, by a more intensified control which is still being improved and developed. These are, of course approximate figures, inasmuch as they relate to restricted areas and times. But, on the other hand, it is always difficult to interpret statistics, even when they are more complete. In the case of road traffic, and in particular of Italian road traffic, there are a large number of uncertain factors for two important reasons: traffic is increasing greatly all the time and the means of inspection and control also improve and continuously become more extensive. In other words, there is a continuing change in the situation and, furthermore, the means by which the situation is observed are developed and become more accurate and extensive.

If it is desired to analyse the general statistics it becomes even more difficult to attribute to speed the main cause of each accident; but it can be said that without doubt speed is at the root of any road accident and, in any case, the factor determining the seriousness of the accident. After making these reserves, it might be of interest to look at some overall figures of accidents which have been recorded in Italy in the first two months of this year, compared with those of the first two months of last year, that is prior to the coming into force of the present speed limit regulations.

Jan. and Feb.	Accidents	Dead	Injured	12 most important towns		
				Accidents	Dead	Injured
1959	28,213	861	19,358	15,670	108	8,159
1960	32,034	822	20,400	17,555	107	8,390
Difference in percentage	-13.5%	-4.5%	-5.47%	-12%	0.9%	-2.8%

Fatal cases are calculated by taking into account only those who die instantly or soon after the accident.

These figures, as was to be expected, have been taken at once as evidence of their arguments by those who hold opposite views, i.e. both by those who say that speed limits are effective and by those who maintain that they are useless and even harmful. The former point out that the number of fatal accidents has decreased in spite of the tremendous increase in traffic and it must be presumed, therefore, that even the number of injured, and of accidents in general, would have been greater without the beneficial effect of speed limits. The latter say that the speed limits have done nothing but increase the number of accidents and of the injured, whilst the number of

fatal accidents has not increased for the simple reason that the increase in traffic has automatically resulted in a lower speed and, consequently, there have been less serious accidents.

Both viewpoints could be argued indefinitely on the basis of these points that because one of the merits of statistics is that they seem to have something to please everybody. Although, in this particular case, it would be rather an exaggeration to say that speed limits can cause an increase in the number of accidents.

At the moment what is more interesting is to examine the various difficulties in applying the speed limit regulations, which are probably the result of the traffic crisis that is occurring all over the world. The first difficulty is the relative reliability of speedometers, more so as the difference of one kilometer more or less per hour (from 55 to 56 km. per hour) could mean a serious fine, instead of a small one, or even the possibility of imprisonment. However, these are technical objections which do not prejudice the soundness of the principle. The speedometers used so far in Italy (the Radar apparatus and photographs of the vehicle which is being followed) do not seem to be able to give a very accurate estimate of speed.

Another difficulty is the prejudice that any speed limits must necessarily have a bad effect on the traffic. Some people's objection to speed limits is that the 50 km. limit in built-up areas, in the villages, will inevitably cause an unnecessary slowing down of traffic and, consequently, traffic jams. But this, of course, is from the technical point of view a very weak argument because, as everybody knows, the maximum capacity of a road is achieved by a speed even lower than 50 km. per hour and, therefore, this speed limit is a very good device to avoid traffic jams and ensure the maximum capacity of a road. But this objection is partly justified as regards the 'personal' slowing down of a vehicle, practically isolated in a nearly empty road. This could seem to the driver to be an unnecessary restriction on the average speed which he could maintain on his journey in those particular conditions.

But, apart from any theory, it must not be forgotten that the main reason for speed limits in built-up areas, and particularly in villages in which there are main traffic arteries, is to safeguard the safety of the population. In the majority of cases, village roads do not yet offer sufficient safety to pedestrians, and a great number of houses, shops and schools are dangerously near the main road. These reasons are sufficient to justify the speed limit regulations even if they did have a bad effect—but they do not—on the traffic in general.

One should proceed carefully, as the maximum speed allowable does not depend only upon the permanent characteristic of a certain road, but also upon its changeable characteristics, such as the intensity and the nature of the traffic at certain times, the visibility conditions, the temporary state of the road surface and so on. In other words, we have to resolve with a single and inflexible expedient an extremely changeable and complex situation.

If imagination is allowed to travel into the future, it can envisage a system of 'control stations' from which, on the basis of continuous observation on televised pictures showing traffic and road conditions in specified areas, signals could be sent from time to time to indicate the maximum speed that is advisable under the circumstances. It must be admitted that the present speed system can indicate reasonable limits for only one of the many possible situations.

As regards the speed on roads outside the urban areas—which for the time being is only limited for certain kinds of vehicles and on some specified places on the motorways—Italy has not yet used the option, granted by the code, to apply special limits in specified cases.

Whereas the object of a general speed limit, which can be modified in special cases, for instance on motorways and on main roads, is only to abolish excessive speed, which is always a danger in itself, on open roads, to the ordinary traffic which, perhaps in Italy more than anywhere else, is a remarkable mixture of very diverse vehicles: lorries, bicycles, and in many cases where there is no pavement available, a considerable number of pedestrians.

Whilst the remarks made above with regard to roads in built-up areas apply also to other roads, speed lovers can rest assured that, practically, a speed of even only 80 km. per hour covers nearly all the vehicles going through main roads and it is higher than the average speed on the most modern motor-roads; and the rare exceptions show that the lamentable increase in the number of vehicles overtaking is caused not only by those who, by driving too slowly, force everybody else to overtake them, but also by motorists who, driving at an excessive speed, insist on wanting to overtake everybody. This question of vehicles which travel too slowly is always raised by those who advocate freedom of speed and it is undoubtedly a serious question, even if it cannot be used—as some would like to—as evidence of the advantage of high speeds.

Whilst there are vehicles whose speed is restricted (such as bicycles and carts), there are on the other hand vehicles which could accelerate but persist on going slowly, mainly for economic reasons, and industrial vehicles which, owing to the weight which they may have to carry, cannot maintain a regular and acceptable speed under any conditions.

In Italy different and specified speed limits have been established for this kind of vehicle for safety reasons: to obviate the disastrous effect of accidents and to facilitate the delicate manoeuvre of overtaking these vehicles which are different, in size as well, from the others.

Some vehicles are granted complete freedom of speed (theoretically in some cases the speed limit is 200 km. per hour or more) whilst others have to adopt very low speed limits (40 km. per hour on open roads for certain vehicles), and this aggrevates a situation that is already absurd and clearly shows the necessity for separate carriageways for the different speeds. From this point of view, it is obvious that a reasonable policy would be to abolish, on the one hand, excessive speed, and to promote gradually, on the other hand, an evolution of the slower and heavier vehicles so as to make them less dissimilar from the other vehicles which are compelled to use the same roads.

2. VOLUME AND SPEED

By F. D. HOBBS
Paviors Lecturer in Highway and Traffic Engineering

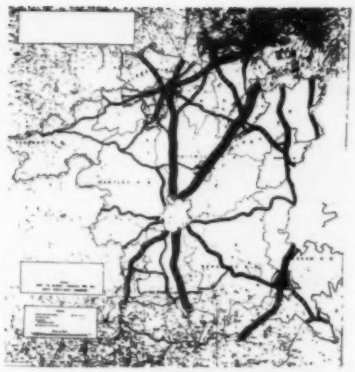


Fig. 1. Typical Flow Map for main rural roads.

THE first article in this series dealt with some aspects of the purpose of data on volume and its analysis. It is important, however, for the understanding of traffic movement to study in greater detail the significance of distributions of volume both by rate and time. The method of analysis is straight forward; histograms, together with cumulative frequency curves, can be drawn up for the percentage of total annual traffic carried at various selected rates of flow usually expressed as a percentage of the annual average hourly or daily volume. Of interest to the traffic engineer is the range and extent of the demand for purposes of traffic control and economic design. Care must be taken with congested urban routes as the desired peak rates of flow will often be concealed by the inadequacy of the existing road facilities. In general, the results obtained for one route can then be used for daily or hourly volume computation for application to other roads where similar conditions are known to prevail but only general information is available such as total annual traffic. If accident studies are also being made it is necessary to have records of weather conditions as well.

It must always be remembered that where existing flows are being used for the establishment of a route requirement over a period of say 20 years that, in addition to normal traffic growth, great care must be taken in estimating the generated traffic which is closely related to planning changes and also produced by the improvement in road conditions. Diverted traffic is more readily ascertainable and can be dealt with by methods of assignment. Unfortunately at the present time, straight percentage increases are being used in many cases (ranging from 75 per cent to 150 per cent) but this situation is likely to prevail until more traffic studies have been completed and a firmer basis for design established. It may also be said that the method employed for comparing various traffic type compositions, by using conversion factors to establish passenger car units, is unwise. For design purposes it is far easier to relate capacities under the required design conditions to the type and proportion of the vehicles in the stream. The present gap between vehicle performance of various classes is likely to be reduced and it has been shown that the effect of heavy vehicles in a stream in equivalent units to a car may vary between about 1.5 to 4 or more on heavy gradients so that the arbitrary selection of a figure like 3 will not apply to most cases. Overdesign will result from using a 20-year growth figure of say 150 per cent taken on a

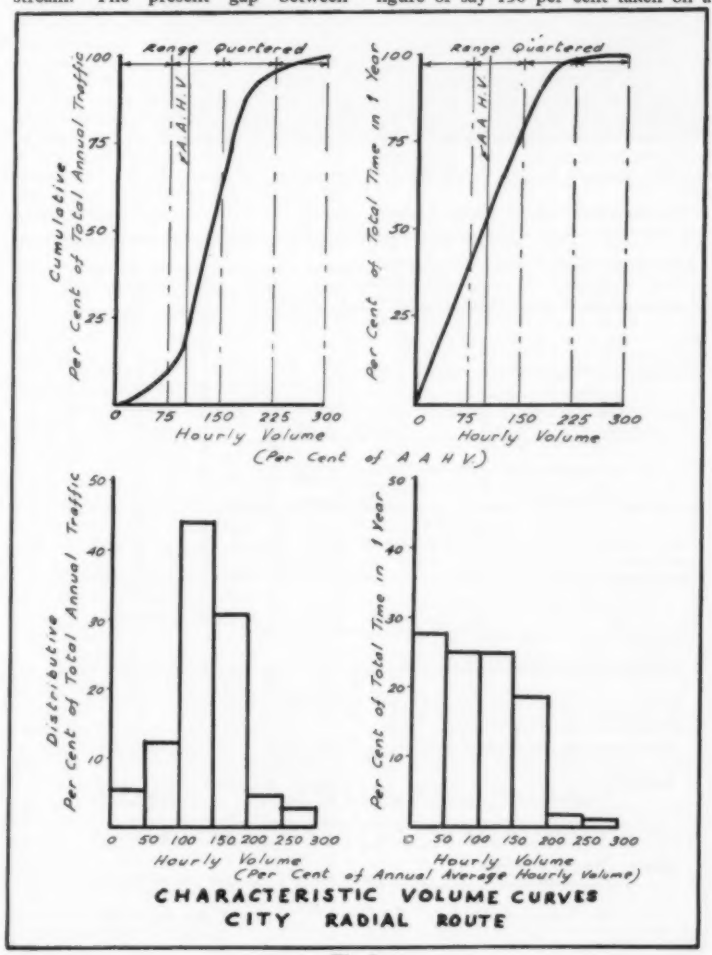


Fig. 2.

passenger car unit figure when it is seen that the rate of growth of heavy and medium vehicles, buses, coaches, etc. is very much lower than that for cars and motorcycles.

It is unlikely also in terms of the rate of expansion of industry in Great Britain that this picture is likely to change, particularly in the long distance freight field, if any return at all is to be achieved from money expended on modernization of the railways, and even the small existing motorway programme should tend to increase the efficiency of the road haulage industry. It would be most helpful for design purposes if these problems were looked into more comprehensively.

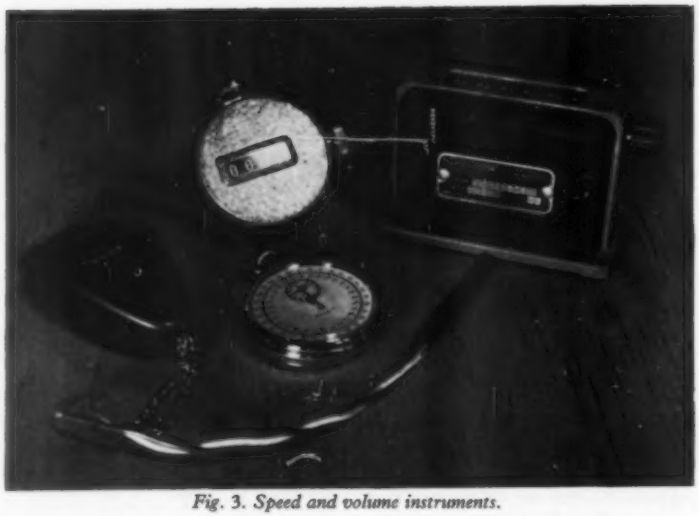


Fig. 3. Speed and volume instruments.

Ascertaining Volume

Before dealing in detail with another major characteristic—speed—there is a further method for ascertaining volume which also provides a great deal of other useful data. This study developed by Wardrop and Charlesworth at the Road Research Laboratory ('A Method of Estimating Speed and Flow of Traffic from a Moving Vehicle' by J. G. Wardrop and G. Charlesworth. Proc. Inst. Civ. Engrs., Part II, vol. 3, p. 158, 1954), can be carried out by observers and a car using only the simplest of equipment. As all traffic engineers should spend a considerable part of their time behind the wheel of a vehicle on the routes within their jurisdiction in order to have at hand experience of conditions at all hours of the year, this method can become part of a routine programme. Adequate knowledge of the problems involved in traffic work can only be obtained by first hand experience.

The observers' vehicle makes a series of runs in each direction over the selected route which is split into predetermined sections. Each section should have similar prevailing conditions throughout and commencing and terminating generally at such points as major intersections. The number of runs would normally be about 10 but the figure may vary from a minimum of about 6 to a maximum of 16. It is desirable to employ two cars, particularly in heavy flow conditions, where there are marked peaks in the volume. The journey observer records on a prepared log sheet times of stopping and starting at intermediate points and at section control points with a stopwatch preferably graduated in hundredths of a minute. The second observer records the number of vehicles in required classifications moving in the opposing direction to the test car. The tally observer counts the number of the vehicles in the sections moving in the same direction as the observer's car that are passed or pass the observer's car. The simple hand tally counters are quite sufficient for most classes of this counting work, each observer recording the cumulative totals at the ends of the sections. Electrical counters mounted on the journey log board and operated by push-buttons by the second observer are helpful in reducing fatigue in heavy traffic conditions. More expensive apparatus using a hole punched tape which has a number of individual channels, and uses a standard teleprinter, automatically records all the data ready for high speed analysis by an automatic reader. Another method employed successfully at the University of Birmingham with only one observer has been adopted using a portable tape or wire recorder with a predetermined code. These portable recorders have been found to be a great benefit in all types of traffic study work and can of course be used for a variety of work.

ROUTE	Observer 1			Obs. 2	Observer 3	
	Control	Stop	Start / Pass	Counter	O'taken	O'taking
HALL STREET	T. Signals		0·0			
Newton Street	T. Signals	3·21 3·43 3·74	3·38 3·60 3·79			
Broad Hill Road 'Z' Crossing	Police	5·62 5·90 6·72	5·73 5·98 6·84			
WOOD STREET	T. Signals	8·38	8·48 8·50	105	12	10
Yardley Road	Rdbt.		✓			

Section Hall St. to Wood St.

	Journey Time (minutes)	x = no. of cars met	y = tally count
Average of 10 runs (North)	8·95	112	1
Average of 10 runs (South)	9·84	125	−1·5

Volume

Southbound volume $q_1 = \left(\frac{112.0 + 1.0}{8.95 + 9.84}\right)60 = 360$ v.p.h.

Northbound volume $q_2 = \left[\frac{125.0 + (-1.5)}{8.95 + 9.84}\right]60 = 394$ v.p.h.

Mean Journey Time

Southbound $\bar{t}_1 = 9.84 - \left(\frac{-1.5}{6}\right) = 10.09$ minutes

Northbound $\bar{t}_2 = 9.95 - \frac{1}{6.56} = 9.80$ minutes

Fig. 4. Observer's log sheet.

The traffic volume in one direction for each section of the route is obtained directly from the formula:

$$q = \frac{x + y}{t_a + t_w}$$

where q = vehicles per minute in one direction,

x = number of vehicles met travelling against the stream,

y = number of vehicles overtaking test vehicle minus the number of vehicles overtaken,

t_a = journey time of observer travelling against the stream,

t_w = journey time of observer travelling with the stream.

Average journey time,

$$\bar{t} = t_w - \frac{y}{q}$$

(*Concluded on page* 349).

PARKING METERS

by J. T. DUFF,
M.Sc., A.M.I.C.E., A.M.I.E.E., F.S.S.

A Senior Engineer at the Ministry of Transport, describes how parking meters work, what is required under British legislation and the facilities offered by the British-made meters illustrated.

Fig. 1.
The 'Park-o-Meter' automatic meter, manufactured by Venner Ltd.

THE first parking meters made their appearance in the U.S.A. in 1935 on the streets of Oklahoma City. Although the inventor, Carl Magee, was optimistic about the parking meter he probably never imagined that it would spread as rapidly as it has done. A survey taken in the U.S.A. in 1952 showed that in the 17 years since its inception the number had risen to 1.1 million and there are certainly more still today. Of the cities in the U.S.A. of over half a million population only Baltimore was reported as having failed to be intrigued by the tinkling of nickels and dimes in parking meters. In recent years the parking meter has spread eastwards and there are now few countries in the world which do not have some or at least are seriously considering their use. The first meters in England appeared on the streets of Westminster in 1959.

The necessary legislation permitting the use of parking meters on the streets was contained in the Road Traffic Act of 1956. Prior to this there were no powers for charging for parking on the street. An important provision of the Act was that any surplus revenue obtained from meters must be devoted to the provision of parking places off the street. To be legal any parking meter used on the streets in this country has to comply with regulations made by the Ministry of Transport.* The aim of these regulations is to safeguard the interests of the motorist using the meters and to ensure some uniformity and precision in the performance of meters. This article reviews the facilities available in the light of these regulations.

The parking meter consists basically of a timing mechanism which is started by the insertion of a coin, and an expired flag which appears when the time paid for has elapsed and which can readily be seen by an attendant patrolling the area. Two types of meter are permitted by the regulations—the *automatic* meter for which the timing mechanism is started only by the insertion of the coin and the *manual* meter for which the driver has to turn a handle or operate a lever after insertion of the coin. These names relate to the action of the driver who uses the meter. As far as the authority who owns the meters is concerned the roles are reversed. The automatic meter is manual in the sense that a man has to be sent round at intervals (usually once a week) to wind the clock in the meter, whereas the manual meter is automatic in the sense that the operation of the handle or lever automatically winds the clock. Figs. 1 and 2 show both types of meter.

The meters can be set either to give a single period of time for the insertion of a single coin or allow the option of different periods, according to the coinage inserted, up to a given maximum. In London, for example, the meters are set to give one hour for sixpence and two hours for two sixpences or one shilling. The option of different periods raises a number of complications. In London the choice must be made by the driver on arrival—he is not permitted to opt for one hour initially and to return subsequently and purchase the second hour. This is to guard against 'meter feeding', i.e. the purchase of time beyond the maximum permitted of two hours from which it would be visually indistinguishable. A further complication is the treatment of time unexpired from a payment by a previous user. Two kinds of meters are made and most manufacturers offer a choice of either kind. With the *cumulative* meter, time left in the meter is added on to that purchased up to the maximum permitted. For example, if 45 minutes were showing on the meter

*The Parking Meters (Description and Testing) (England and Wales) Order 1957. S.I. No. 822.

Fig. 2. 'Parkomatic' manual meter, by Parking Meters (Europe) Ltd.

when a driver arrived, insertion of sixpence would set the meter to 1 hr. 45 mins. With the *cancelling* meter the 45 minutes would be cancelled and only one hour given. With either type the insertion of sixpence with, say, 1 hr. 10 mins. showing would set the meter to the maximum permitted of 2 hours.

Both cumulative and cancelling meters raise various administrative problems. For example, why, if 45 minutes can legally be added to the purchased one hour from a cumulative meter, should not a driver be allowed to avail himself of the 45 minutes without payment if this is sufficient for his needs? (This is not at present allowed in London). Although the cancelling meter removes this difficulty it introduces another—the so called 'grace period'. Clearly the motorist must be given time to insert the second sixpence before the meter starts to cancel. The interval between the insertion of the two coins can be appreciable, e.g. if the driver has to ask his passenger (or passers by) for the second sixpence.

There seems to be no definite evidence as to the effects of the two types on revenue and parking turnover. Some loss of revenue is to be expected from cumulative meters, e.g. a driver who needs only 1 hr. 30 mins. might get this for sixpence instead of for one shilling from a cancelling meter. The extent to which this happens in practice is not known. Again it is possible that a motorist who would have been satisfied with an hour may stay longer with a cumulative meter which gives him more than an hour for sixpence and so reduce the turnover of spaces. On the other hand he might speed up his business to take advantage of free time obtained from a cumulative meter. It is likely that the overall effect on turnover is small. On the whole the cumulative meter appears to strike the motorist as fairer. Most meters can be very simply converted from one type to the other if an authority decides to change after experience.

The regulations require a parking meter to have a scale and pointer to show at any instant how much unexpired time remains. The scale has to be graduated in time intervals of not less than two minutes or more than five minutes. The usual arrangement is for the scale to be fixed and the pointer to move over it, but it is also possible for the pointer to be fixed and the scale to rotate. The pointer is generally separate but it is also possible for the expiry flag to be used as a pointer. Fig. 3 shows an example of the flag being used as a pointer.

At the end of the time paid for (plus any additional time given by a cumulative meter) the regulations require a flag or other device to appear suddenly as an indication to the attendant that action is required. Most meters have a separate flag which appears in the same window as the scale, but one meter has a ball, visible from all angles, in a separate compartment (see Fig. 4). Either the pointer or the scale can be made to function as a flag in addition to its normal function. Since the expiry device is required to appear suddenly, arrangements have to be made for rapid travel of pointer or scale at the appropriate time if either functions as a flag. The disappearance of the flag is also taken as an indication that the motorist has inserted a coin in the meter.

If a motorist leaves his car at a parking meter beyond the time allowed by the meter he becomes liable in this country for an excess charge which, in London, has been fixed at ten shillings. The attendant is responsible for attaching a notice to the windscreen of the car when the excess flag appears notifying the driver that the excess charge has been incurred. The excess charge has to be paid to the local authority running the meter scheme. If payment is not made within the prescribed time the authority traces the owner of the car from the registration number and the owner is required to give the name of the driver if he himself was not driving at the time. Provided the driver pays

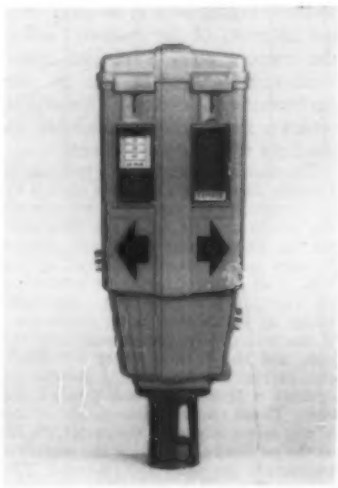


Fig. 3. 'Duopark' twin automatic meter by S. Markman, Ltd.

Fig. 4. Red Ball automatic parking meter.

the excess charge within the prescribed period he commits no offence by incurring an excess charge. However, there is a further period, *the excess period* (two hours in London), timed from the appearance of the excess flag, after which it becomes an offence to leave the car at the parking meter and the driver then becomes liable to police prosecution. In London it was thought advisable for this excess period to be timed by the parking meter and for the end of the period to be denoted by a second flag. The regulations were framed to permit of such a 'double-flag' meter but it should be noted that its use is not compulsory. Other authorities can, if they so wish, have the more usual single flag meter. In London the first two hours of the scale which times the period of paid parking is white, the second two hours which times the excess period is coloured yellow and any remaining part of the scale, during which an offence is committed, is coloured red. The excess flag is coloured yellow and the penalty flag red to correspond with the colouring of the scale. To meet the wording of the 1956 Act, which allows certain presumptions to be made regarding the correct functioning of the meter when, and only when, the excess flag appears, it is necessary for the excess flag to remain showing when the penalty flag appears. In one meter which uses the scale as a flag, it is necessary for the yellow portion of the scale to remain showing when the red portion appears. The double flag meter as described above should not be confused with an American manual meter in which a second flag is used to denote that the meter is not working correctly or that the motorist has failed to turn the handle fully. One British meter (Fig. 2) has three flags, the third flag appearing after insertion of the coin and until the handle is fully turned.

Fig. 5. Manual meter by Brecknell, Dolman & Rogers, Ltd.

Under the regulations the only coins permissible are sixpences and shillings but a two-period meter may be specified to take sixpences only or both sixpences and shillings. In London the maximum of two hours is obtained either by insertion of two sixpences or one shilling. Under the 1956 Act itself it is only possible to prescribe two charges and two periods, the standard amount for the standard period and half the standard amount for half that period. The effect of all this is that an authority could not decide to have meters which gave say one hour for threepence and two hours for one shilling.

When meters are constructed to take both sixpences and shillings, it is possible to have a common coin slot or two separate slots. Fig. 5 shows an example of the latter. The maximum height and width of these slots is carefully specified so that coins larger or thicker than sixpences or shillings cannot be inserted in the meter. Undersized coins may be dealt with in two ways—there may be a mechanism inside the meter which sizes the coin and prevents operation of the meter if it is under size or it may be allowed to operate the meter provided it is visible to the attendant through a window. The minimum sizes are also prescribed in the regulations. These dimensions have had to be carefully chosen so as to include the manufacturing tolerances of the coins, and the wear which may occur before they are withdrawn from service, and yet reject the majority of common foreign coins. Meters which take both sixpences and shillings through a common slot present some difficulty with regard to coins intermediate in size between the sixpence and the shilling (the farthing comes under this category). Most manufacturers have now succeeded in making meters which do not operate on these intermediate sizes even though they continue to provide one or two windows to render the last coin or coins visible. The presence of a window should not therefore be taken as an indication that the meter does not discriminate between legal and non-legal tender. Coins which do not operate the meter generally remain inside the meter but models are available which return such coins to the motorist.

Authorities are free to make their own choice as regards the type and arrangement of the coin collecting box. It is usual for the coin box to be in a separate compartment opened by a key different from that which gives access to the mechanism so that maintenance staff cannot touch the coin box. The box itself may be a simple container which can be sealed in the treasurer's department, or it may have a lock to which only that department has the key. Some arrangement is usually made to prevent coins being shaken out or extracted with a knife. Considerable ingenuity has been shown in the design of some of these coin boxes to prevent possible theft by the collectors. A counter can be provided to count the number of sixpences inserted (a shilling operates the counter twice). Fig. 5 shows such a counter. This is not required by the regulations and does not seem to appeal to Local Authorities.

A *twin parking meter* is defined as one relating to two adjacent spaces. Two types of twin meter are made. In one (Fig. 6) there are two entirely separate mechanisms (identical to those used in the single meters made by the same firm) whilst the other (Fig. 3) is designed as a single mechanism with a common clock for the two halves. The regulations permit the use of either single or twin meters.

Fig. 6. 'Karpark' twin automatic meter by Karpark (a single version is also manufactured).

The regulations also lay down requirements for ensuring accuracy of operation. For example, where the standard period is two hours the pointer has to reach the zero mark on the scale in not less than two hours or more than two hours and four minutes. If the standard period is an hour the tolerance is two minutes. From the instant the pointer reaches the zero mark the excess flag must appear suddenly and not earlier than one minute and not later than three minutes later. Similarly, the penalty flag in a double flag meter must appear within one to three minutes of the pointer denoting the end of the excess period.

Whilst an attempt has been made to achieve some uniformity in operation, and to safeguard the user, local authorities are permitted, nevertheless, considerable freedom in their choice of parking meters.

Traffic Instruments—*concluded from page 346*

The method can be used for one-way streets by selecting upper and lower speeds but it is more difficult to carry out particularly in heavy traffic conditions. In many cases the tally observer can have additional tasks such as time contouring, determining parking indices, studying pedestrian crossings, and other delays, etc.

Speed

Before discussing the methods of measuring speed it is as well to understand the importance of this characteristic and the types of speed to be studied. The types of speed used by the traffic engineer can be divided into three main classes. the first known as spot speed can be defined as the instantaneous speed of any selected vehicle at any selected point on the highway The other two main classes of speed are usually known in Great Britain as journey and running speeds. Journey speed is derived by dividing the total length of road under consideration by the total journey time, including all delays; and the running speed can be found by dividing the length of road under consideration by the total journey time less the total stopped time.

Measures and studies of speed characteristics are needed from year to year in the examination of trends in the overall pattern of highway usage and also particularly for traffic control purposes such as the correct size, siting and type of signs. Speed plays its part in the selection of horizontal and vertical sight distances on roads and at intersections, and for determining the need for road and intersection improvements or the installation of traffic signals. Accidents also require knowledge and study of speed particularly in relation to before and after studies. In addition, the designer must allow for the correct operating speeds for major new roads and particularly at intersections. The imposition and operation of speed limits on existing highways is a further task and the need for differential speed limits is becoming greater but these require careful selection. Enforcement of speed limits at the selected values is of course essential. In general, information in these categories will express a measure of efficiency for a road and is most important for congestion studies, the costs of vehicle operation, economic studies and particularly benefits to be derived from improvements and new construction. Also one of the principal factors of assignment of traffic to new facilities depends upon relative journey times for new and old routes.

UNIVERSITY COURSES IN HIGHWAY & TRAFFIC ENGINEERING

PROFESSOR W. F. Cassie of The University of Durham, (Department of Civil Engineering, King's College, Newcastle upon Tyne) in 1952 set up a Section to study traffic engineering. The Department was represented at the first conference held by the Road Research Laboratory on the subject of Traffic Engineering. In the first few years of the 1950's, the Section carried out research work on traffic flow in and around Newcastle upon Tyne, and introduced instruction in Traffic Engineering into the undergraduate course. By 1955, after publication of some of the results of the first researches, a Final Honours Year Option in Highway and Traffic Engineering was introduced into the Honours course for B.Sc. in Applied Science.

At about this time, the Department moved into a new building where there was more scope for development, and Dr. T. E. H. Williams spent the summer of 1955 at the Institute of Transportation and Traffic Engineering of the University of California, where courses for University Professors were being presented. In the next session, 1956-57, a Postgraduate University Diploma course was started, the International Road Federation sending two of their Bursars to take the Diploma, and, in the same year, four younger members of the Department took a King's College Certificate.

Since the first official start to this course about thirty men have studied, at varying levels, the linked topics of Highway and Traffic Engineering. Many of these men came from the Commonwealth, a number have been resident in this country, and a further five have carried out research work in traffic flow for higher degrees. The course for the Postgraduate University Diploma lasts for three terms, aggregating a total of twenty-six weeks. No work is required of the student in the summer. The prerequisite necessary for entry into the course is a degree in Civil Engineering or its equivalent. If the student is of the right calibre and a graduate, he may proceed to a Master's degree (M.Sc.) with one year's residence in the University after carrying out research and study in Highway and Traffic Engineering.

Details of the Diploma course are given below, but since some of the subjects are well understood they are not described in such detail as is Traffic Engineering which, because of its relatively unfamiliar nature, is given in full.

(A) Traffic Engineering

Basic Traffic Studies

Traffic Counts: sampling systems: analysis and presentation of data.

Origin-Destination Surveys: methods of processing of data manually and by electronic computer.

Human and Vehicular Characteristics: reaction times; braking; deceleration; physiological and psychological factors.

Accidents: analysis of contributory factors; collision and condition diagrams.

Speeds and Delays: speed-flow; spot speeds; statistical methods.

Capacity: two-way and one-way traffic flows; intersections.

Parking Surveys: techniques for collection, analysis and presentation of data.

Potential Traffic for New Roads: diverted, generated, development and trend components.

Traffic Regulation and Control

Traffic (light) signals: optimum cycles; design of signal phases; co-ordination for simple and flexible progressive systems.

Channelization: carriageway markings and islands.

One-way traffic systems.

Parking facilities: parking meters; parking garages; layout for optimum capacity and location for maximum economic return.

Road (traffic) signs: shape; colour; size; legibility; location.

British Highway Law: Road Traffic Acts.

Field Studies and Laboratory

Classified traffic counts.
Origin and destination surveys.
Spot speeds.
Journey times and delays.
Analysis of accident records.
'Before-and-After' studies.
Delays at traffic signals.
Capacity computations.

(B) Highway Lay-out and Construction

Highway Economics, Geometric Design, Materials of Construction, Pavement Design, Drainage, Lighting, and Skidding.

(C) Statistics and Design of Experiments

A normal course on engineering statistics including regression analysis and analysis of variance.

(D) Soil Mechanics and Foundations

This course assumes a basic knowledge of soil mechanics, and deals with more advanced topics.

(E) Principles of Town and Country Planning

Background of British law and practice with particular reference to highways and transport.

After his first five years of work in leading the Section in the study of Traffic Engineering, Dr. T. E. H. Williams was invited by Northwestern University to take a temporary appointment as full Professor. He accordingly spent the session 1957-58 in the United States in supervising research, and in carrying out teaching at undergraduate and postgraduate levels. He also gave courses to American highway and traffic engineers already in practice. On his return, he read a paper at the International Traffic Study Week in Copenhagen on his researches into the behaviour of traffic in Chicago. During the year in which Dr. Williams was in the United States, the Section was under the charge of Professor John Hugh Jones of the Institute of Transportation and Traffic Engineering of the University of California. Further research was carried out during this period and a large origin and destination survey made on behalf of the Tyne Tunnel Joint Committee.

During its eight years of existence the activities of the Highway and Traffic Engineering Section have been assisted by the International Road Federation, and by the Trustees of the Rees Jeffreys Road Fund. Annually since 1956, the I.R.F. has sent two postgraduate Bursars from the Commonwealth—all practising engineers; the Rees Jeffreys Road Fund has for several years maintained a postgraduate scholarship which has been used for research in traffic flow. One of the results of these researches (by Brian Helm) is to be published shortly in *Traffic Engineering and Control*. The Rees Jeffreys Trustees have also made a subscription to the cost of running the Section, and have assisted travel. The British Road Federation, the Cement and Concrete Association, and the Roads Campaign Council have collaborated with the Section to mount Exhibitions.

In April 1961, in collaboration with the Departments of Architecture and Town and Country Planning of the University of Durham, the Department will hold an International Symposium on URBAN SURVIVAL AND TRAFFIC to which speakers from different parts of the world have agreed to contribute papers. Details of this Symposium will be announced soon in this Journal.

PROFILE . . .

of a

TRAFFIC ENGINEER

ROWLAND NICHOLAS

'WE may as well visualize the time,' says Rowland Nicholas, City Surveyor, Engineer and Planning Officer of Manchester, and President-Elect of the Town Planning Institute, 'when everybody who has to travel to work by car.'

A man of direct statement, he has a simple and direct view of our present troubles, namely, that we still ignore the use of the car. Streets of houses are still being planned on a basis of about one family in nine or ten owning a car. So only one family in nine or ten has anywhere to leave the car, except outside the house, unless its members are bursting with the energy or public spirit to drive it to a garage and walk home, rain or shine. Similarly, we put up commercial buildings that look modern, but with space in the basement for the cars of only a small proportion of the occupiers, and these car parks, exude traffic into the congested streets through their several independent space-wasting ramps.

With only one car per family the number of motor-car licences will double in the next twenty years. This must create entirely new problems in our central commercial areas which might best be accommodated by redeveloping large areas comprehensively with buildings on stilts, so releasing virtually the whole of the ground space for vehicular and open space uses. These open spaces could often enclose those buildings of historic or special architectural importance which should be preserved. Such a development would enable pedestrian ways to be provided at first floor level, clear of all traffic movement. Inevitably, Nicholas sees the whole accompanied by a system of motorways in urban areas, which would not however be allowed to traverse the inner centre. These motorways would be provided with grade separation at all road junctions.

'Proof and Persuasion'

Meanwhile—since even far less ambitious construction of roads and buildings needs time for completion—traffic engineering remedies must be applied to develop the fullest capacity of what we already have. Nicholas's technique might be described as 'proof and persuasion'. First comes the investigation, as, for instance, the peak-hour checks on Manchester's main thoroughfares. Then, with 'proof' of substantial delays, appropriate remedies would be applied. For instance a slight change of routing for buses might relieve junction delays. Sooner or later, however, as traffic continues to increase, slowing down is bound to recur.

'So then you apply traffic engineering again,' says Nicholas, 'till you can do no more and hope the new roads will be ready before there is complete chaos'.

If anyone has the alertness and resilience to keep starting all over again, it should be Rowland Nicholas, who has averaged two to three years' service with each of nine different local authorities till coming to Manchester in 1940. Even as a boy, he was determined to get on or seek chances abroad.

He was born in Burnley, Lancashire, nearly sixty years ago, but grew up in the south. He was not a particularly imaginative boy. He liked making models of boats, buildings and railways, and played practically every game except ice-hockey. Just missing the 1914-18 war, but feeling that, as one of the eldest of a large family, he should set out for a job rather than the university, he was first attracted to the then new opening, wireless. In the end, however, opportunity occurred for him to be articled to the Borough Surveyor of Guildford. From the start, Nicholas set his sights high. They included reaching a senior position by the age of thirty and getting eventually to a large County Borough. He beat his own first objective, becoming Assistant Borough Engineer at Brighton at twenty-eight. He achieved his second at thirty-six, as City Engineer at Sheffield.

Wherever he went, however, in those inter-war years, he came up against the inescapable problem of the slums. Examining buildings, condemning or repairing, he became interested in how people live, and then in people themselves, the most important factor of all, he insists, and too often lost sight of by the technician.

In 1940, Nicholas reached Manchester as Surveyor, with responsibility for Town Planning. Four years later, the position was amalgamated with that of City Engineer. Even before that, however, he must have felt that he had come home. He is too practical a man to ascribe to heredity the fact that he enjoyed getting back to Lancashire and seemed to have a natural understanding of the people. He merely records the fact gratefully, and that in Manchester he has been able to do the most satisfying work of his life, namely the production of the 1945 City of Manchester Plan. Part of this Plan provided for the development of a new Civic Centre and, as the new Law Courts are now nearing completion at one end of this Centre, with the Town Hall at the opposite end, it is to be expected that the greatest efforts will be made by all concerned to fill in the central section, and so complete a Centre worthy of the City's regional importance. Other projects in the Plan are also well in hand, including very substantial extensions to the

(*Concluded on page* 356)

Combined Road Operations

West Riding

THE largest combined operation for raising the capacity and safety of an existing road is that taking place by way of both new construction and major improvement along the line of the Great North Road. The reconstruction varies from new motorway construction with limited access, to the highest standards for all-purpose roads. The greater part of this work is under construction in the West Riding where the whole of that section of the A1 which passes through the county will either be by-passed or converted to dual-carriageway. On completion, there will be 36 miles of dual-carriageway within the county, of which 26 will be continuous. Of the 15 schemes with an estimated cost of £15 million, two have been completed and seven are under construction. All the work is being carried out by the West Riding County Council, acting as agent for the Ministry of Transport, with the County Engineer and Surveyor, Col. S. Maynard Lovell, responsible for the projects.

Doncaster By-Pass

The only section being constructed to full motorway standards is the twelve-and-a-half mile Doncaster by-pass, which has the dual purpose of acting as a relief road for through traffic on the Great North Road and as a junction between the proposed London-Yorkshire Motorway and the Great North Road. it runs from Tickhill to the junction with A1 at Redhouse, and involves the construction of 28 bridges. The design provides the means for traffic entering and leaving the Motorway by the Sheffield-Grimsby Trunk Road A630 at Warmsworth, and also the Doncaster-Barnsley County Road A635 at Marr, using slip roads. A 280-foot diameter roundabout at Redhouse near the Great North Road provides a junction with the Redhouse-Skipton-Kendal Trunk Road A638. The large-scale improvements at present in progress on the A1 and A614 roads are designed to ensure that the Motorway serves its full purpose as a high speed artery.

The design of the roadway is in accordance with Ministry of Transport standards, with dual 24-foot wide carriageways, a 15-foot wide central reservation, and nine-foot wide hard shoulder. The curves are designed for a safe speed of 70 m.p.h. and are super-elevated with transitional approaches. A standard side slope for cuttings and embankments of one in two is adopted, but certain cuttings in boulder clay have a slope of one in three, and in the particular case of the magnesian limestone cutting at Warmsworth, the side slope is one and one-half in one. The aim has been to obtain a gradient on the Motorway itself, in no case steeper than one in 26, and also to obtain a visibility distance of 800 feet on each carriageway. The standard is relaxed slightly in one or two instances on account of the conditions existing in certain areas.

Drainage of the Motorway is by means of french drains in cuttings, or alternatively gutter drains are used at the sides of rock cuttings, both being connected to main drains as necessary. Where the motorway is on an embankment, drainage works consists of an open ditch at the bottom of the embankment, surface water from the hard shoulders flowing over the side slope. Where a super-elevated carriageway slopes inwards a french drain is placed in the central reservation. Due to the probability of mining subsidence, heavy-duty reinforced concrete pipes with flexible joints have been specified for main drains, and for pipe culverts passing under the Motorway. Using these pipes, no concrete surround is required and flexibility is achieved by means of a rubber ring at the joints, this being rolled into position as the pipes are laid.

Rigid construction not being advisable, the carriageways are flexible, consisting of a sub-base of graded material, a base eight inches thick of cement bound granular material, and asphalt wearing surface to a depth of four inches. The greater part of the rock excavated consists of magnesian limestone which is particularly susceptible to frost damage, so a minimum construction thickness of carriageway of 18 inches has been adopted. An appreciably greater thickness is required in certain soils; for instance, on boulder clay and marl the construction thickness required is about 28 inches.

Of the total length of the Motorway in the contract, six and a half miles is in cutting and six miles in embankment, the material derived from the cuttings being used, where suitable, for the embankments.

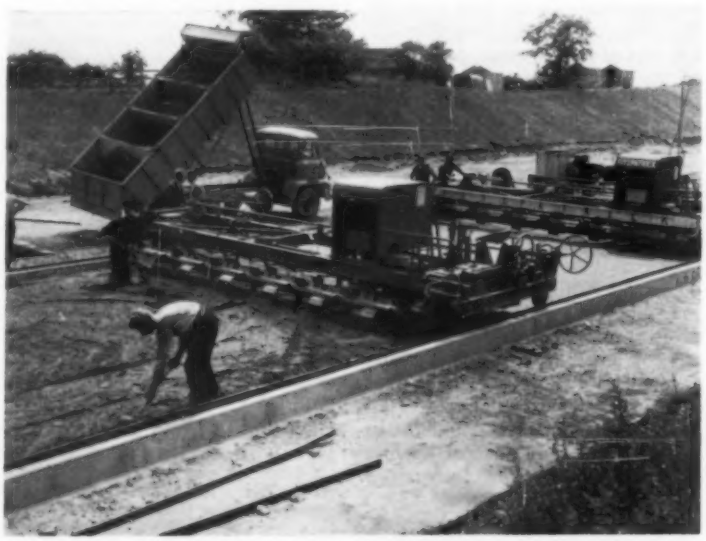


Fig. 1. *Doncaster By-Pass. Laying Base: Regulator and Compactor.*

Types of Bridges
The bridges can be divided into: four span bridges carrying existing roads over the Motorway; single span bridges carrying the Motorway over existing roads; railway bridges; footbridges; the major bridge over the River Don and a number of Culverts and Subways. There are also three two-span bridges in the congested Warmsworth area carrying existing roads over the Motorway.

The Don Bridge under construction is a seven-span viaduct comprising two parallel but separate structures 760 feet in length between abutments. Four of the spans will be 100 feet each, two 90 feet and one over the river 180 feet in length. There will be two 24-foot carriageways and the overall width of the bridge will be 86 feet. Traffic on the bridge will be separated from the parapet by an eight-foot wide hard shoulder which will have a crossfall away from the railings of one in 30 for increased safety.

The by-pass was designed by the County Engineer and Surveyor and the contractors are Cubitts Fitzpatrick Shand.

Details of some of the other improvement schemes are as follows:

Fig. 2. Doncaster By-Pass. South end of Ducker Holt Cut—looking South: Sub-base laying in progress.

Wentbridge By-Pass
1.85 miles in length, comprises a dual-carriageway highway with an overall width of 87 feet, each carriageway being 24 feet wide, and having a central reservation 15 feet wide and 12 feet wide margins on the outer edges, each incorporating an 8-foot hardened shoulder. It is being built to a design speed of 60 miles per hour, with gradients not exceeding one in 30, sight distance is 600 feet, and acceleration and decelerations lanes are being provided at junctions. Construction is of the flexible type, the pavement thickness varying to suit the California Bearing Ratio of the underlying sub-base material.

In-situ concrete marginal strips will flank each edge of the carriageways which is being constructed on an approved sub-base varying in depth according to the design thickness of pavement and will comprise a premixed cement stabilized granular base eight inches thick and a two and a half inch thick hot-rolled asphalt base course surfaced with one and a half inches of high stone content hot rolled asphalt.

Contractors are Taylor Woodrow, Ltd., and the cost about £750,000.

Redhouse to Wentbridge
This scheme constitutes in the main the duplication of the four and one-half miles of existing single-carriageway road between the Doncaster and Wentbridge By-passes by the provision of a new carriageway 24 feet wide. The road was designed to the standards required by the Ministry of Transport, based on a design speed of 60 miles per hour; maximum gradient is not to exceed one in 30; sight distances for traffic are to be 600 feet with the provision of acceleration and deceleration lanes at each side road junction; curves with radius are planned as large as possible with utilization of transition curves where required.

A central reservation of varying width, together with a margin 12 feet wide incorporating an eight-foot hardened shoulder and in-situ concrete marginal strips will be provided. In addition a length of two miles of the existing carriageway is to be reconstructed.

The carriageways which are of flexible construction will have an approved sub-base of varying depth according to the design thickness, premixed cement stabilized granular base eight inches thick, and a two and a half inch thick base course of hot-rolled asphalt surfaced with one and a half inches of high stone content hot-rolled asphalt.

Contractors for the scheme are George Wimpey & Co., Ltd., and the cost is £760,000.

Wentbridge—Ferrybridge Roundabout
The design standards are similar to those for the Redhouse to Wentbridge Improvement scheme described above, and comprise a two-mile duplication of the existing single-carriageway together with the construction of 0.65 miles of new dual-carriageway highway with an overall width of 92 feet. Each carriageway is 24 feet wide, having in-situ concrete marginal strips along each edge, and a central reservation of 20 feet width, except that the central reservation on the duplicated length will have to vary according to circumstances. Hardened shoulders eight feet wide are provided in the 12-foot margins to the carriageways. Construction of the road is similar to the previous schemes and the final surfacing is with high stone content hot-rolled asphalt on a bituminous macadam base course.

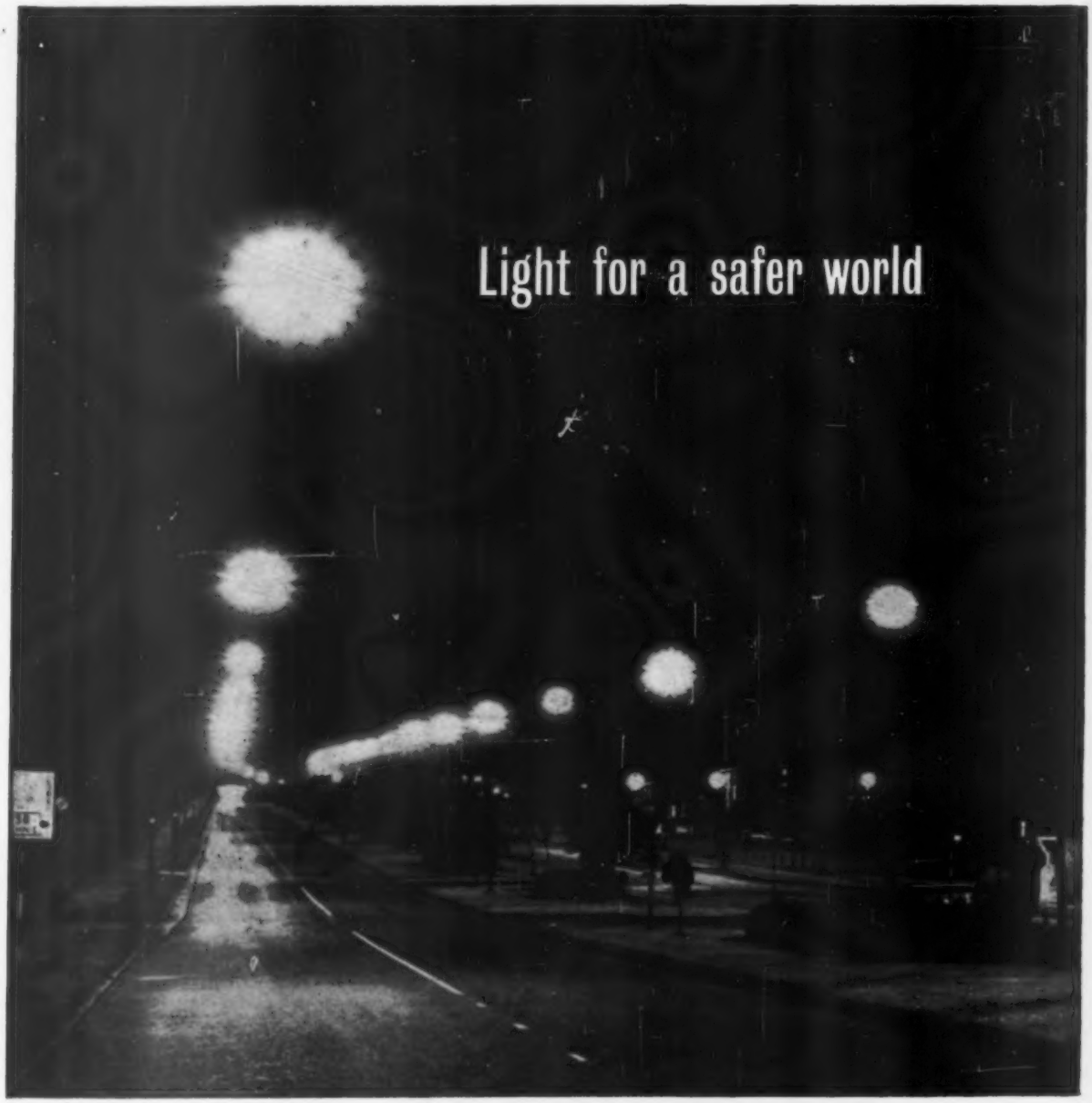
Contractors are McLauchlan (Knottingly) Ltd., and the cost is £255,000.

Brotherton By-pass
With design data the same as that for the Wentbridge By-pass, this scheme has a length of 1.01 miles together with a uni-directional link road 0.25 miles in length leading to A162. It consists of a dual-carriageway highway with an overall width of 87 feet varying to 102 feet at two points where the central reservation is widened to 30 feet. Hardened shoulders are provided in the margins on each side and the carriageways also have in-situ concrete marginal strips. The construction of the carriageways will be similar to those mentioned above, but the final surfacing will consist of two and a half inch thick dense tar base course with one and a half inch thick dense tar surfacing. The Contractors are Harbour & General Works, Ltd., and the cost £486,000.

Wetherby to Allerton
Four miles in length, basically this scheme comprises the provision of a new 24-foot second carriageway to dual the existing single-carriageway to the same design data as the Redhouse to Wentbridge scheme. A considerable amount of reconstruction of the existing highway has been carried out as the existing road was sub-standard, Carriageway construction is similar to those previously mentioned, with a final surfacing of one and a half inch thick high stone content hot-rolled asphalt on a two and a half inch bituminous macadam base course.

The contractors are Crowley Russell and Co. Ltd., and the cost £488,000.

Allerton to Boroughbridge
With design data as for Redhouse-Wentbridge scheme, this consists of the duplication of the existing single carriageway by the construction of a new 24-foot carriageway for a length of three and a quarter miles between Allerton Station Diversion and Gibbet Hill, Boroughbridge. Also included are the construction of new dual carriageway highways in three diversions at Allerton Grange, Claro House, and White Gables Café for a total length of one and three-quarter miles. The diversions have an overall width of 87 feet, comprising 24-foot carriageways, 15 feet wide central reservation, and 12-foot margins incorporating eight-foot hardened shoulders. The construction of the carriageways is similar to those previously described and will have a final surfacing of one and a half inch thick high stone content hot-rolled asphalt on a two and a half inch thick hot-rolled asphalt base concrete.



With road safety a major consideration, this ¾-mile stretch on the main Glasgow-Edinburgh road is now lit by 52 high wattage Sodium lamps developed by Philips Electrical Ltd. The new system was largely the inspiration of Mr. Denis Colvin, City Lighting Engineer to the Glasgow Corporation, who co-ordinated the activities of Philips on lamps and gear, the Engineering & Lighting Equipment Co. Ltd. in their development of the new ELECO Golden Ray '280', and of Messrs. Stewarts and Lloyds, who provided the special steel columns. In operation it is no longer possible for confusion of light sources to be an accident hazard and the reduction of the number of columns used reduces the number of possible collision points.

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PUBLIC LIGHTING ENGINEERS IN CONFERENCE

HOW a sense of responsibility could contribute to the changing scene in public lighting pervaded the Conference of the Association of Public Lighting Engineers at Folkestone last month. It was appropriate that 'The Changing Scene' was the theme of the Conference, because the standard practice based on the British Code of Practice for Street Lighting, 1935-37, is being re-examined by a committee of the British Standards Institution with a view to drafting a new Code. The Conference was therefore more concerned with the future than the past, although some time was devoted to reviewing progress that had been made during the last 25 years. Taking the lead here was the former Borough Engineer and Surveyor and Planning Officer of Barking, Mr. Curzon Harper, who surveyed the changing scene in vivid terms.

President Sets the Task

It fell to the President, Mr. F. C. Smith, to strike the keynote of the Conference's task at the outset, by summarizing the many aspects of the changes now occurring which the Conference should study. He defined these as:

(1) The growth and importance of increased vehicular traffic on the roads of Great Britain, and the influence of the rapidly changing conditions on road engineering practice and design.

(2) The inter-relation between increasing traffic density and road accidents both during the daylight and after dark.

(3) The contribution that public lighting can make to the safe and expeditious movement of traffic during the hours of darkness, and the changes in the standard of public lighting that may be necessary as a result of modern road engineering design and the employment of surfaces of improved non-skid qualities but having inferior reflecting properties.

(4) Analysis and study of the visual task imposed on road users by modern conditions after dark, and to inquire how the information required for seeing objects in the ever-changing field of view, presented during movement along a road, can be made available by appropriate design of street lighting installations.

(5) The greater technical facilities now available to the public lighting engineer to meet the more exacting demands of present-day practice.

Many of these new 'tools' have resulted from fundamental research followed by technological development in fields of inquiry directly concerned with light production, and allied phenomena. In addition, as is so often the case, work in other spheres, which at its inception had no obvious application in public lighting practice, has proved of value and the results used with both technical and practical advantage.

(6) Exchanges of experience between practising public lighting engineers dealing with the new conditions which are ever arising and demanding urgent attention and prompt decision.

Having set the Conference its task, the President spoke of the increased roads programme and expressed the hope that financial assistance for the provision of adequate public lighting would be available because without it the full advantages of the new roads could not be realized.

In view of this, delegates to the Conference who attended the annual luncheon were disappointed to hear Mr. J. F. A. Baker, Chief Engineer (Highways) Ministry of Transport, deputising for the Joint Parliamentary Secretary, Mr. John Hay, announce that it was not proposed to provide lighting on rural motorways nor at their junctions, but only at roundabouts at their terminals. He contended that from the experience of M1 there were no grounds to justify a change in this policy, but he did soften the blow slightly by saying that the position with regard to urban motorways would be different and that that was the problem that lighting engineers would be well advised to look into.

Problems that Remain

'Progressive Changes in Public Lighting' was the subject of the thoughtful, factual and constructive paper contributed jointly by T. M. Lappin and H. Robertson, who defined fundamental problems of street lighting to remain as the provision of 'the greatest safety at night on the roads for all users by producing the best seeing conditions at the most economic cost'.

Features of importance in the changing scene were summarized by them as:

(1) The studies of modern traffic engineering indicate that major changes in road dimensions, design and layout, together with the provision of fly-overs, underpasses and similar aids to traffic movement, are essential to the safe and rapid progress of traffic under the conditions which have developed and continue to develop on the road systems in Great Britain.

(2) Minor roads, due to re-routing of traffic in cities, or increased traffic density, etc., have to deal with traffic conditions for which they were not designed nor intended.

(3) The building of motorways raises acutely the question as to whether public lighting of the highest order is not essential to the realization of the greatest possible economic value of these roads.

(4) Cities and shopping centres are assuming increasing importance, and the growing prestige and civic pride demand in many cases special lighting in harmony with architectural features and dignity.

To which they added this comment:

'So far as the Public Lighting Engineer is concerned these considerations represent more exacting conditions if he is to satisfy the demands of drivers and pedestrians for safe and speedy travel, and may well demand standards of lighting and installation design on some roads well in advance of existing practice, if the accident risk during the hours of darkness over that obtaining during the day-time is not to increase.'

The authors of this paper also expressed concern at the economies imposed upon lighting authorities and stated that it was regrettable that even today the lower limits of the Code of Practice were imposed on economic grounds, particularly on those authorities who had heavy borrowing commitments in the provision of new lighting in housing estates and for programmes of conversion from gas to electricity.

After stating that in all fields of lighting today it was widely recognized that for high visual efficiency it was necessary to have high illumination, they suggested that in future planning regard would have to be made to the still relatively large proportion of all-purpose roads, where street lighting was not up to Code standards. They added that:

'Nothing will be gained by setting higher levels of illumination for general purpose roads which lighting authorities might not be able to afford and badly designed installations will not be improved merely by increasing lumens per 100 feet linear of road. This does not suggest the restriction of the use of the more powerful sources available on general purpose roads but much

experimental work has still to be done to prove that they can be used on such roads to give more effective installations than are given by present Code standards and spacings.'

Justification for their point of view was provided by an analysis they made of public lighting data which showed some 50 per cent of lighted roads in the country had not yet reached existing Code standards of lighting, and in their view the raising of the standard on those roads, where lighting is still below standard, up to Code levels should not be disregarded because of the desire to provide higher than Code levels on, for instance, general-purpose roads. They suggested that as long as this position persisted only in the case of special-purpose roads should higher standards of lighting be applied.

The authors questioned whether the broad classification of roads on which the Code was based was still relevant today:

'The Ministry of Transport report, which is now twenty-three years old, adopted a broad division of roads into two classes with a distinct and easily recognizable difference between the limits of lighting adopted for each. In the Code of Practice, Group A Traffic Routes are defined as: "All those roads which form the main approaches to or traverse important centres of population, or pass through detached built-up areas, and on which there is appreciable pedestrian traffic."

'All modern trends are towards lighting for traffic, the assumption being that adequate lighting for traffic meets pedestrian needs also.

'The question arises therefore whether the very broad classification of roads in the two documents is still relevant today. Motorways apart, we now have new road features and patterns and traffic on a scale far greater than it was twenty years ago. Certain residential roads, too, carry more traffic, local it may be, than formerly and parking of cars in residential streets is now quite a problem.

'To raise the levels of lighting of the present code for all Group A roads may not be desirable as many roads in this group, either by their local use or by their width or on both grounds, are adequately lighted at present code standards.

'While recognizing the difficulties associated with a re-classification, an attempt should be made in any revision of the Code to introduce a category embracing those roads which we have called special-purpose roads and which today are recognized as requiring levels of lighting beyond those of the existing code. Relatively this will be a small proportion of the total of Group A roads in this country.

'The Code of Practice itself states that the volume and type of traffic will be a predominant factor in deciding upon the level or type of lighting to be provided and it may be that the further category of roads suggested could be determined by the traffic density and the presence or absence of a speed limit.

'Roads which would fall into the category in mind are main traffic routes through cities or conurbations with or without a speed limit, ring roads, by-passes and roads in town centres congested by vehicles and pedestrians. Flyovers and underpasses could be included but their structural features may call for separate consideration.'

The authors believe that this policy in the end would be preferable to increasing the range of the level of lighting for all Group A roads as at present defined and leaving the Lighting Engineer or his Council to determine the standard for each street on its own merits.

In regard to motorways, flyovers and underpasses, they had this to say:

'It would appear at first sight that the lighting of motorways would be an ideal application of the higher power and more efficient light sources available today. Much investigation and experiment will be required to find the desirable level of lighting, the method of providing it and whether a standard form or pattern of lighting should be devised for all motorways. In these experiments, no doubt, account will be taken of the possibilities of conventional systems, of cut-off light distribution and uni-directional lighting. As the lighting of motorways is likely to be more expensive than in more normal traffic routes the last, with its lower running cost, merits the fullest consideration. Control of glare would be an important factor.

'The lighting of fly-overs and underpasses has been carried out fairly successfully by conventional lighting systems and the problems are not so different perhaps from the lighting of other roads as in the case of motorways. They do, however, introduce some of the features associated with the lighting of tunnels and bridges and glare is an element which must be controlled. Unlike motorways each fly-over and underpass may call for individual treatment and regard must be had to the type and standard of lighting on the approach and leaving sides of both fly-over and underpass. The problems may be quite different at different sites.

'The lighting of these traffic engineering features requires the co-operation of all parties concerned from the initial stages and efforts should be directed to having the lighting considered as an integral part of the road plan from the outset of a project. Indeed there is probably need for some national body being set up to co-ordinate the interests.'

Technological Advance

In a paper entitled 'Trends in Technology', Mr. J. G. Holmes, Technical Director of Holophane Ltd., reviewed some of the technological advances and examined how they could contribute to public lighting. He went through the various light sources examining the progress that had been made in each. Of filament lamps, which he claimed were still the basic lamp, there were some rapid developments taking place in regard to the technique of temperature measurement in the laboratory, and in the provision of standard 'heat test' lamps which would enable greater precision in design and in the testing of the lanterns in which the lamps were used.

Of the sodium lamps he said it might be that recent improvement would allow the development engineers to rest on their laurels for a while, possibly until the street lighting engineers had been able to provide the improved installations which were available.

He claimed that fluorescent lamps were showing improvements in efficiency, colour rendering and life performance and that these trends would doubtless continue steadily until some scientist made a new breakthrough in his research into fluorescent powders and that there would then be another burst of new lamps of improved properties. Meanwhile, however, he suggested that the present level of performance was very high, and public lighting had benefited from the wholesale adoption of tubular fluorescent lamps in industrial and commercial lighting fittings.

Mr. J. M. Waldram of the Research Laboratories of the General Electric Company, Ltd., in a paper on 'Surfaces, Seeing and Driving: Some Recent Studies' traced the conception of the mechanism of street lighting and discussed the modifications which should now be made in design to match the changing properties of the surfaces found on streets today.

Profile

concluded from page 351

University, which are in fact being prepared much more quickly than was originally envisaged.

Nicholas has been responsible, too, for the replanning of Wythenshawe as a New Town, a self-contained nucleus, with its own industry and commerce, and already supporting a population expanded since the war from 40,000 to about 100,000.

Nicholas's reputation in planning extends far beyond Manchester. He has investigated problems and solutions in many parts of the world. Just after the war, in a group approved by the government, he visited Poland to advise on Town Planning. In Rio de Janeiro he found examples of building on stilts with pedestrian ways beneath which impressed him very much and made him conscious of the effect on city centre development which a large-scale use of this type of construction could produce.

The usual gigantic amount of reading that seems to go with this kind of work is his lot, including the local newspapers, but he refuses to let criticism affect him. He has the faculty of shutting the office door on the job, though he can equally, if needed, take a problem home to think out, as if it were a plan he had to study. He has disciplined himself to give time to recreation, physical and mental, and plays an indifferent game of golf whenever he can. He enjoys the theatre, ballet and the lighter operas, but strongly protests he is no highbrow. His very catholic taste, however, stops short of rock and roll, though he did dance as a young man. Nicholas has never married.

No doubt, like most of us, he has his obstinacies, but when a new idea is presented to him, he will give it honest, and if necessary, long consideration, and will take the greatest care that the wording of his answer is as explicit as he can make it. His feelings for the importance of human beings and his practicality have combined to develop his technique of 'persuasion', which is really nothing more nor less than an honest presentation, as simple as he can make it, of the expert view.

A.P.L.E. EXHIBITION-FOLKESTONE

THIS Exhibition, which was staged for the Association of Public Lighting Engineers' Conference at Folkestone from September 13 to 16, contained some very interesting stands. A great many new models were shown alongside the well-known and established equipment. Unfortunately it is not possible to give the fullest details of all the stands in these pages, but a selection of the exhibits has been made while further details of all items shown are available.

The following manufacturers, amongst others, had stands at this Exhibition.

Atlas Lighting Ltd.

Pride of place on the Atlas stand was taken by the two lanterns and columns by Abacus, which this year won Design Centre Awards from the Council of Industrial Design—the Gamma Four post top mounting lantern on Abacus 2560 column for two 250 watt or 400 watt colour corrected Mercury Fluorescent lamps, and the Gamma Five post top lantern on Abacus 1510 column. All the lighting fittings, which received these coveted awards this year were Atlas products. Among the other interesting exhibits seen were the entirely new Gamma Three-lantern for one 250 watt or 400 watt MBF/U lamp.

T.E.C. 53 for further details

A.E.I. Lamp and Lighting Co. Ltd.

A new A.E.I. side entry 'Amberline' lantern was shown which, with the existing spigot entry lantern, will make for greater flexibility in the use of Mazda 200-watt sodium linear lamps. It was mounted in the centre of the stand over a simulated re-lamping platform, to enable visitors to test servicing and re-lamping procedure.

Introduced last year, the 200-watt sodium linear lamp is the first practical light source in the world to achieve an efficiency of 100 lumens per watt. Together with the 'Amberline' lantern it gives the street lighting engineer the means of providing higher intensities at conventional spacing and mounting heights. The new lantern is intended primarily for group 'A' roads and provides a non-cut-off, medium angle beam. The side entry 'Amberline' lantern mounted on a 35 ft. Stewarts and Lloyds column was shown in the outside display, where a varied selection of nine lanterns were mounted on 15 ft., 25 ft. and 35 ft. columns.

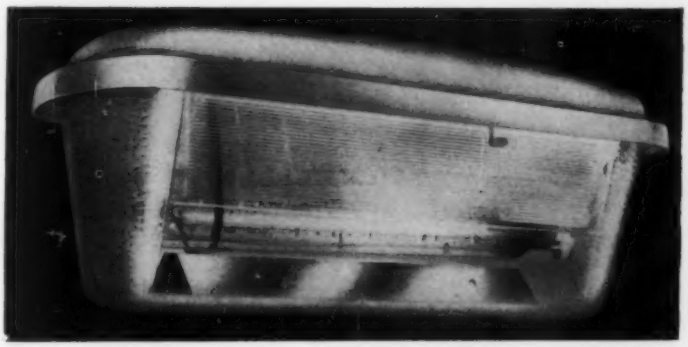
A display of lamps used in street lighting was shown separately under fluorescent, tungsten, mercury and sodium groups. Lanterns shown for 'A' class lighting included the 'Kington', for three 5 ft. 80-watt fluorescent lamps; the 'Brampton', an enclosed refractor/reflector lantern for one 250 or 400-watt colour-corrected mercury discharge lamp; and the 'Amber', for use on 'A' or 'B' class roads, housing one 45/140-watt sodium vapour discharge lamp. Lanterns for B' class lighting included five types of the 'Kirby', for use with 75/200-watt G.L.S. tungsten lamp or for 80/125-watt mercury discharge lamp; the 'Ashby' for use with 100/200-watt G.L.S. tungsten lamps or 80/125-watt mercury or colour-corrected lamp mounted in a 'Leader 15' light alloy column; the 'Residential Mark II' enclosed lantern for use with two 2 ft. 40-watt fluorescent lamps; and the baby 'Amber' enclosed top entry lantern for one horizontally operated 40/60-watt sodium vapour discharge lamp. In addition to these, the display includes the 'Pole Top' enclosed lantern for four 5 ft. 80-watt fluorescent lamps, which can be used in town centres, shopping areas and boulevards, where appearance and colour of light are important.

T.E.C. 54 for further details

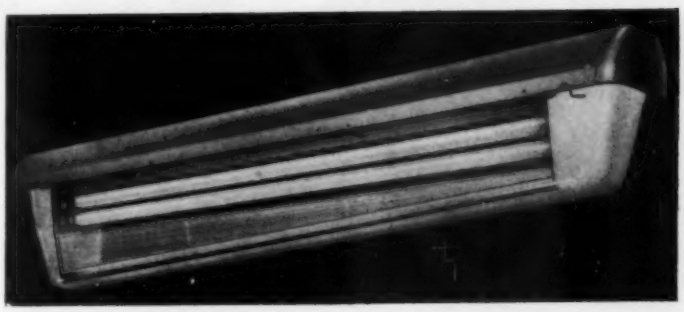
General Electric Co. Ltd.

This year G.E.C. exhibited ten entirely new street lighting lanterns. These, together with a small selection from the current range, illustrated the constant endeavour of the Company's Lighting Division to improve the performance and appearance.

Interest is being shown in higher levels of illumination and increased mounting heights with wider spacing, and the trend was reflected in the introduction of three lanterns suitable for this type of installation. The first uses the Osram 200 W. linear sodium lamp, which was shown for the first time at last year's exhibition. The other two are both mercury lamp lanterns, one with an Osram 250 W. or 400 W. MBF/U lamp with cut off distribution and the other, which has a decorative appearance, incorporates three 250 W. MBF/U lamps. A further new lantern, using 250 W. or 400 W. mercury lamps, is intended for area or space lighting. Also in the main road section, there was a new, post-top mounting, decorative lantern, employing four Osram 5 ft. fluorescent tubes.



Two of the lanterns shown by G.E.C.



Concrete Utilities Ltd.

Concrete Utilities Ltd. included in the column display at Folkestone a new design, the 'New Highway' concrete column for 30 ft. and 35 ft. mounting height, approved by the Council of Industrial Design and available with both steel and concrete brackets, single and double arm. The 'New Highway' was shown in conjunction with the 'Phosware' SO.280 Universal and SO.200 sodium lanterns, and another feature of this comprehensive display is the slimmest Group 'B' concrete column yet, the 'Byway "X".'

T.E.C. 55 for further details

Five new lanterns for side road lighting were displayed, one, housing a horizontally burning mercury or tungsten lamp, has the unique feature of a shallow dish refractor with horizontal prisms, enabling the lantern to be made more compact. A new small lantern, capable of providing a variety of optical systems, was shown, and three

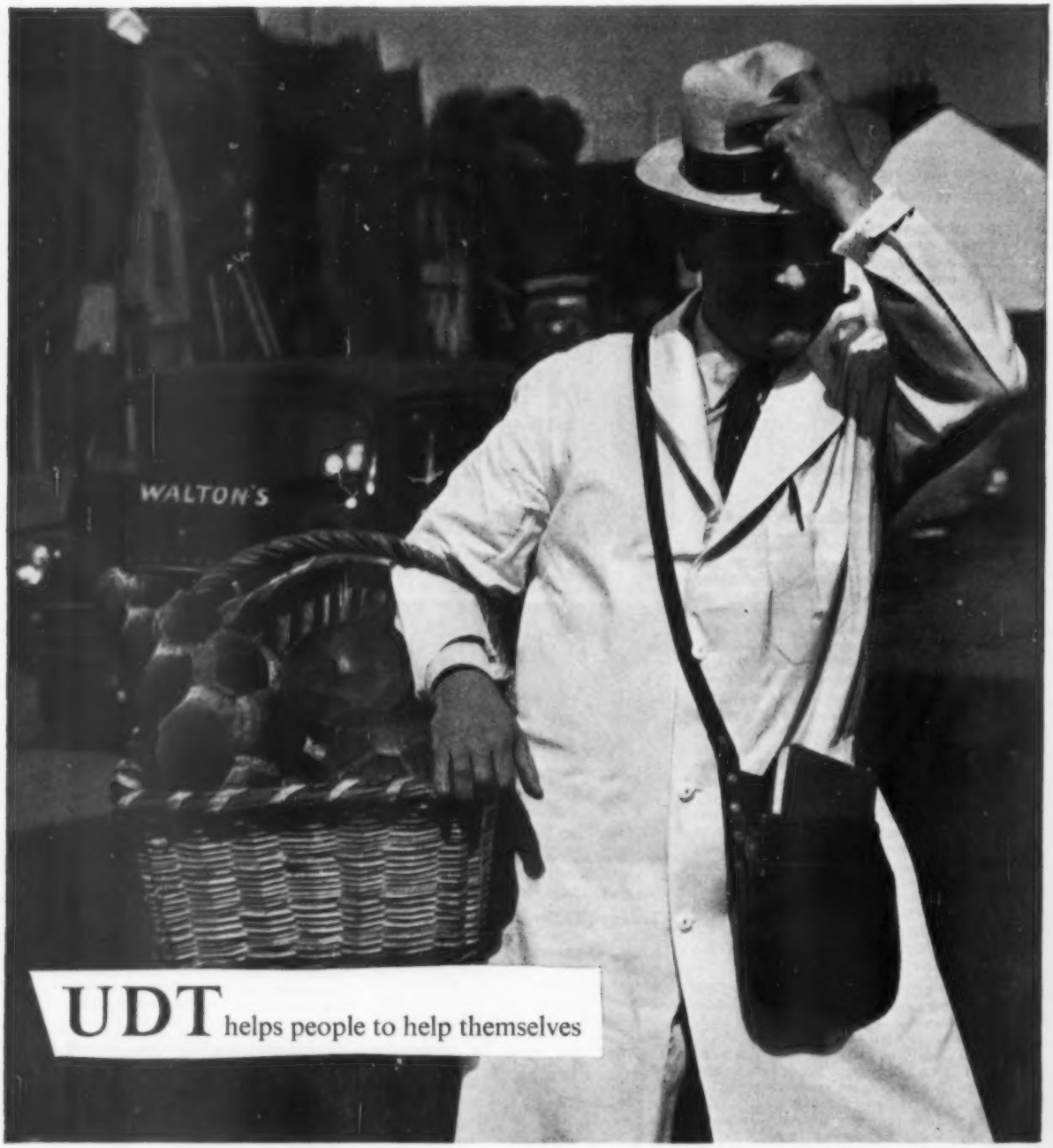
Mr Walton buys another van

(crisp, crusty loaves fresh-baked this morning!)

Tom Walton needed a new van. Needed it here and now. But he couldn't afford here and now to pay the full price. So what was he to do? He could do one of two things. First—wait till he *could* afford the full cash price—several hundred pounds or so. By which time he might have missed the chance to add much extra business, losing substantial profits.

Second—he could buy the van on credit through UDT (which is, in fact, what he did). Of course it meant he paid a little extra: but that extra was nothing to the extra profits of having the van this year instead of next. And UDT also finance the road tax and insurance, spreading these payments too over the months.

By the time he makes the final monthly payment to UDT, Tom Walton expects his van to have paid for itself. Maybe there's no such thing in business as having your cake and eating it—but buying on credit through UDT comes very, very close!



UNITED DOMINIONS TRUST (COMMERCIAL) LIMITED, UNITED DOMINIONS HOUSE, EASTCHEAP, LONDON, EC3 **Assets exceed £174,000,000**

new side road fluorescent lantern. One of these houses two Osram 40 W. tubes, the second four 3 ft. tubes and the third, a single 80 W. tube burning vertically.

In the outdoor section, there was a selection of G.E.C. street lighting columns made in both steel and concrete, and, for the first time, G.E.C. main and side road columns manufactured in aluminium.

T.E.C. 56 for further details

Holophane Products

Holophane displayed their high-efficiency, prismatic, street light control systems in a range of refractors which included the oval bowl (refractor 22/4257.D) for use with 250 W. and 400 W. fluorescent bulb lamps type MBF/U and MA/U lamps of similar rating. Holophane glass provides the smooth exterior refractor with carefully-calculated interior prisms, moulded accurately to ensure full directional control. This refractor was shown also in a new wall-mounting unit accommodating 250 W. or 400 W. fluorescent bulb lamps type MBF/U, for use in thoroughfares where traditional lantern columns could be a serious obstruction or aesthetically unpleasing. The scope of the 'Bi-Way' series of bowl refractors is further extended by two additional glasses displayed. These new designs, Refractors No. 2/4140F and No. 2/4135, have been developed to provide improved performance with the following light sources, achieving a higher peak intensity in the main beams and reducing the amount of light emitted directly across the road:

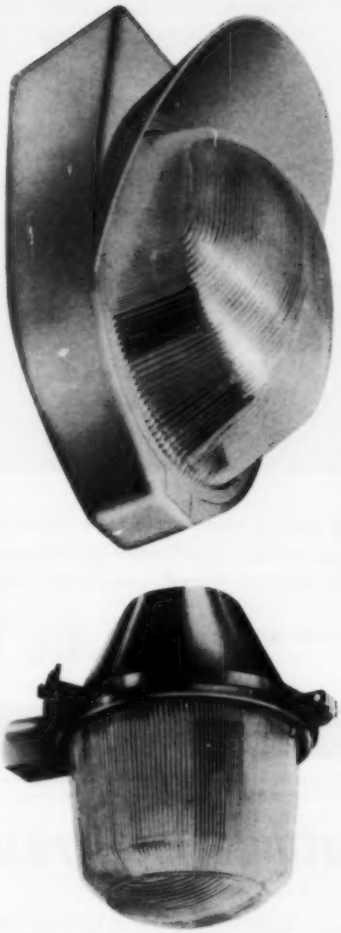
Refractor No. 2/4140F
250 and 400 W. MBF/U
Refractor No. 2/4135
80 and 125 W. MBF/U
100-200 tungsten-filament.

The new refractors are directly interchangeable with the existing 'Bi-Way' types No. 2/4140 and 2/4115 having similar flange and light centre measurements and offer comparable or improved light distribution characteristics with the same range of mercury fluorescent, mercury discharge and filament lamps.

T.E.C. 57 for further details

Horstmann Gear Co. Ltd.

A full range of Horstmann electric time switches was seen at Folkestone. Several new time switches were on view and should prove of considerable interest to all connected with public lighting. These included the latest type 'V' Mark II and 'Q' Mark III time switches. The former has a capacity at 250 volts of 30 amps. AC., and it can be fitted with a solar dial to give two lighting periods and to automatically cut out the early morning lighting for the period of the year when this is not required. The latter is designed principally for the control of multi-tube fluorescent street lighting where two circuits have to be switched on at dusk, one circuit to be switched off at midnight and the other at dawn. Either a synchronous or electrically wound movement can be supplied, the latter incorporating a minimum reserve of 12 hours. The capacity at 250 volt is 10 amps. for each circuit. Other switches worthy of attention include the type 'K' Mark II which is synchronous driven and the type 'Y' Mark II which is electrically wound and incorporates a 12 hour spring reserve. Both are small switches which will readily fit into the base of modern lamp columns where space is normally limited. The capacity of each at 250 volts is 20 amps.



Above is the new 'Hastings' wall unit (top) and the refractor bowl No. 2/4140F on the Bi-Way lantern, displayed by Holophane Ltd.

T.E.C. 58 for further details

Metal Developments Ltd.

This company exhibited eight Group 'B' and two Group 'A' columns.

The four round columns were examples of this company's original Group 'B' lighting column 'LUCERNA'. The volume of orders, and the interest of local authorities throughout the British Isles show recognition of the many advantages of aluminium over the older types of material.

The four Group 'B' hexagonal columns were examples of the more recently introduced 'SHEERLINE' column, designed to take advantage of the reduced dimensions of the newer types of control gear. This graceful column occupies minimum pavement space. The columns were shown with their standard anodized-silver, satin finish. The columns can be supplied with a wide range of bracket arms suitable for any lantern. Among those shown were the 'CAMBRIDGE' unit, which was designed for a scheme involving several thousand columns, of which over 400 have already been ordered. Also shown was the 'ATHERTON', which was supplied to another major scheme during the last year. This unit, which was designed by the Borough Surveyor of Atherton for use on schemes within the Borough, has proved very popular, and many enquiries have been received for supplying this type of column to various parts of the United Kingdom.

The two Group 'A' columns shown were similar in section and general design to the 'SHEERLINE' column, and suited for use with the 'SHEERLINE' on schemes which involve both Group 'A' and 'B' columns. This Group 'A' column is designed for use with the modern, streamlined, light-weight mercury vapour and sodium lanterns.

T.E.C. 59 for further details

Philips Electrical Ltd.

At this year's exhibition, the company featured their now complete range of integral sodium lamps from 45 watts to 200 watts, the latter having an output of 20,000 lumens average throughout its life. This range combines high efficiency with suitability for use in standard fittings and with standard ballasts. The seven ratings—from 50 watts to 1,000 watts—of the mercury fluorescent lamp, MBF/U, were also displayed. Its colour properties were demonstrated as a model red bus passed through three separate zones. The first lighted by an early MA/V lamp, which has now been replaced by the exclusive Philips MBF/U lamp which lighted the second zone. The third had a mercury fluorescent lamp with a significant colour improvement. Floodlighting fittings for high-wattage G.L.S. lamps and for discharge lamps were also on show, and the 150 watt pressed glass reflector lamp. The latter, with its robust construction and heat resistant glass, needs only an adjustable watertight holder to make it the basis of many floodlighting schemes.

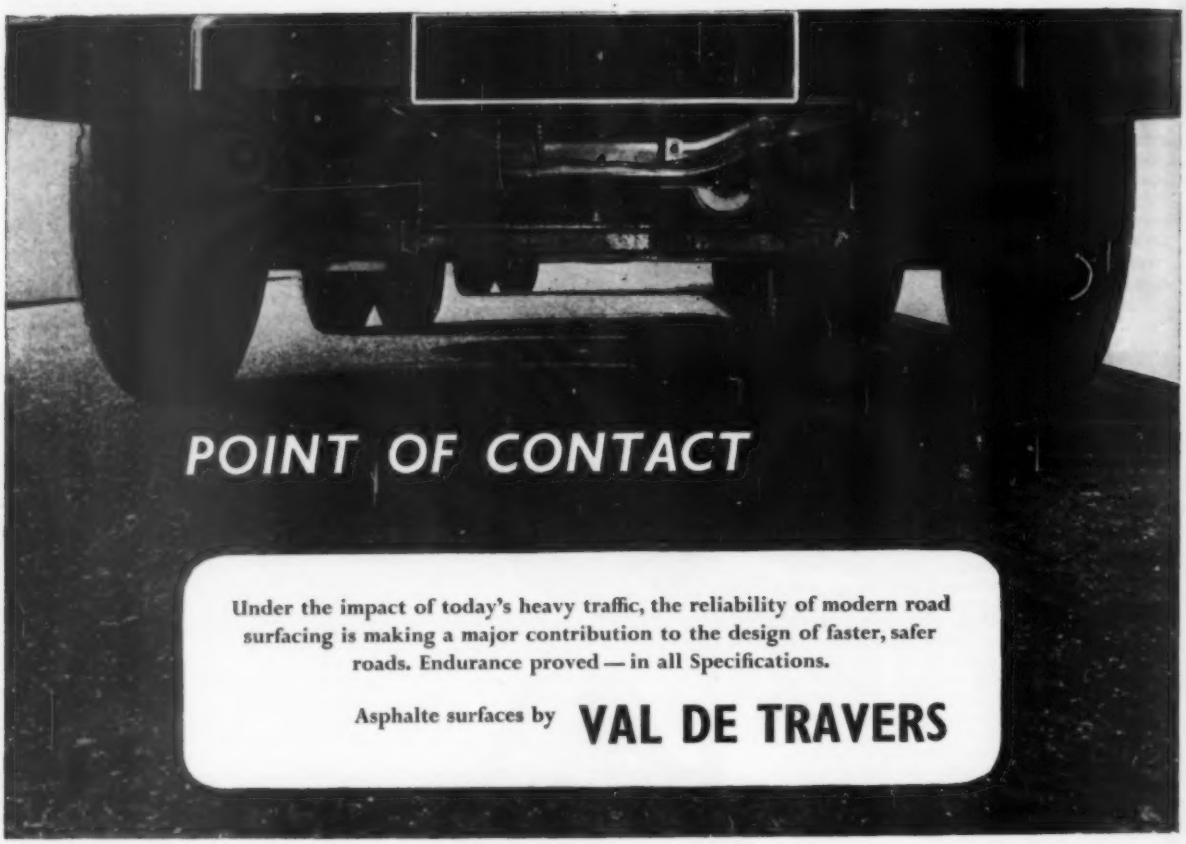
T.E.C. 60 for further details

Phosco Ltd.

The centrepiece of the Phosware stand was the new SO.280 'Universal' and SO.200 sodium lanterns, designed for 30 ft. and 35 ft. mounting height, and available in cast aluminium or impregnated colour fibreglass; also available using a reflector optical system or refractor system. Another feature of the display was the new ornamental wall lantern using two No. 2 ft. × 40 W. fluorescent lamps, a number of which have recently been installed in the Worcester Cathedral Precinct. A selection from the 'post-top' range was also shown, notably the P.107/A, which has achieved immense popularity, and several of the standard fluorescent, sodium, mercury and tungsten designs.

T.E.C. 61 for further details

TEC257 for further information


POINT OF CONTACT
Under the impact of today's heavy traffic, the reliability of modern road surfacing is making a major contribution to the design of faster, safer roads. Endurance proved — in all Specifications.
Asphalte surfaces by VAL DE TRAVERS

Duopark Twin Automatic Parking Meter

Latest short-term kerb parking control
Arrows clearly indicate each parking space and coin-slot
Broad red flags—clear visibility—rapid mobile or foot-patrol check
One clock—one weekly winding—one coinbox serves both spaces
Use one meter on one post to control two cars—posts 40 ft. apart
Really secure coinbox and on-site collection system

Suitable for all climatic conditions
All mechanisms interchangeable—on-site replacement without tools
Vibrations will not affect timing
Instant operation on insertion of coin—last coin in view
Neat sturdily built mechanism—pressure die-cast housing
Greater turnover at kerb and greater earnings towards off-street parking programmes

Do not invite excess-time parking—it defeats metered control. Install the Duopark Twin cancelling type meter as used in many countries.

Phone Hol 2913 — **S. Markman of London Ltd.** — *Cables* Ezepark
143 HOLBORN, LONDON, E.C.1

TEC258 for further information

The post top lantern shown left is the 'Blenheim', which was displayed by Falk, Stadelmann & Co. Ltd.

Poles Ltd.

On the outside exhibition ground, there were ten 'Adastra' columns and a floodlight tower. This display included columns in steel and aluminium, some sectional and others of one piece construction. The sectional columns are of tapered form, aesthetically correct, and at the same time efficient, economical and adaptable for all mounting heights. The sections can be nested within one another so that one column is contained inside its largest section. This forms a compact bundle and facilitates handling, storage and transport. Standard columns are circular or hexagonal in shape but octagonal and other geometrical shapes can be provided in accordance with requirements when large quantities are in demand.

T.E.C. 62 for further details

Sangamo Weston Ltd.

The main features of this display were the Sangamo synchronous time switches. Typical examples from the wide range of models or variants were on show, including the latest developments. All models are totally enclosed in moulded dustproof cases and are of the plug-in type, the base forming the plug receptacle. Weatherproof wall or post mounting boxes are available for use with any model and a conduit entry box is also offered. Time switches for street lighting control include the models S251/13 and S251/14. The former is a single pole, single throw switch fitted with a solar dial giving on and off operations at sunset and sunrise. The Model S251/14 is also fitted with a solar dial and is similar to the S251/13 except that an additional feature allows a fixed off operation between the times 8.30 p.m. and 1.00 a.m. and a fixed on operation between the hours of 3.15 a.m. and 8.45 a.m., thus the lights controlled by the switch will light up at dusk regardless of the time of the year, switch off at, say, midnight and, during winter months, switch on again in the early morning at a fixed time each day, finally switching off at sunrise. Other models shown included ones for use with multiple lamp lanterns as well as spring reserve models. The latter are synchronously controlled when the current is on and have a reserve of at least 18 hours in the event of interruption of supply.

T.E.C. 63 for further details

Falk, Stadelmann & Co. Ltd.

This firm had on their stand a new design, the 'Blenheim', which is suitable for any installation requiring a pole top mounting lantern. The hinged hood facilitates cleaning and maintenance, a desirable feature for large installations and one which will appeal to local authorities responsible for the care of a large number of lanterns. The hood is secured with a simple toggle catch and the 'Perspex' enclosure is in one piece, the top flange fitted with a gasket to exclude water and dust. A refractor fits on to the hinged hood. The lampholder is supported by a steel tube which also carries the wiring, and the arrangement of a dome-type refractor and a clear enclosure can provide for either non-axial, symmetrical or axial light distribution and conforms to the British Standard Code of Practice for street lighting for Group 'B' roads. When fitted with an opal enclosure, the refractor is omitted and general lighting is provided. The bottom entry accommodates a 3 in. diameter by 3 in. high spigot, which is standard on most columns.

T.E.C. 64 for further details

Telephone Manufacturing Co. Ltd.

New and comprehensive ranges of street lighting capacitors are now being manufactured by the Components Division of Telephone Manufacturing Company Limited. Two features of these capacitors are their small size, they fit into even the most confined column space, and wide temperature range of operation. Designed to meet modern requirements efficiently these capacitors measure up to stringent performance needs. There are three types:

TYPE OR—has a temperature range of —40 to +60°C. and a capacitance and tolerance range of 8μf ±10 per cent to 20μf ±10 per cent. This type is housed in an elastomer sealed, welded aluminium case.

TYPE AR—has a temperature range of —5 to +60°C. and a capacitance and tolerance range of 8μf ±10 per cent to 25μf ±10 per cent, and is housed in an elastomer sealed, welded aluminium case.

TYPE HB—has a temperature range of —25 to + 50°C. and a capacitance and tolerance range of 8μf ±10 per cent to 25μf ±10 per cent. This type is housed in an elastomer sealed, welded aluminium case.

The low temperature types are suitable for operation to —40°C., so that they are ideal for outdoor working in the United Kingdom and in all but the severest climates. All types are fitted with fixing brackets for column or lantern mounting, but can be supplied without brackets.

Nine inch leads and shrouds are standard but capacitors can be supplied with alternative leads and without shrouds if required. All capacitors are fitted with a discharge resistor and, if required, an earthing terminal can be fitted on the brackets.

T.E.C. 65 for further details

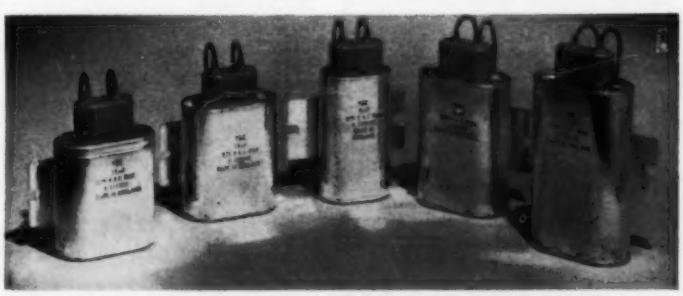
Venner Ltd.

Of special interest on the Venner Stand was a display showing the small physical dimensions of the MSSP time switch with clear plastic cover, allowing it to fit into the smallest of street columns. Also shown was a range of time switches including both synchronous motor-driven (with or without spring reserve) and electrically wound (with spring reserve) and single, double or triple pole types, for loads from 5 to 50 amperes. Latest innovations to be seen were new style, easy to read dials and clear plastic box covers.

T.E.C. 66 for further details

Other exhibitors included:

Abacus Engineering Co. Ltd.; Access Equipment; Associated Electrical Industries (Woolwich) Ltd.; Austin Crompton Parkinson Ltd.; Automatic Telephone & Electric Co. Ltd.; Benjamin Electric Co. Ltd.; Bright, Son & Co. (Clerkenwell) Ltd.; Central Garage Ltd.; George Cohen & Sons Ltd.; Dalbukirk (Street Furniture) Ltd.; Eagle Engineering Co. Ltd.; Engineering & Lighting Equipment Co. Ltd.; Erecon Ltd.; Ford Motor Co. Ltd.; Franco Traffic Signs Ltd.; John Gibson & Sons Ltd.; Gowshall Ltd.; A. H. Hunt (Capacitors) Ltd.; London Electric Firm Ltd. Permanoid Ltd.; Revo Electric Co. Ltd.; Shaftesbury Ladders Ltd.; Siemens Edison Swan Ltd.; Siemens & General Electric Railway Signal Co. Ltd.; Simon Engineering (Midlands) Ltd.; H. C. Slingsby Ltd.; The Stanton Ironworks Co. Ltd.; Stewarts & Lloyds Ltd.; Tubewrights Ltd.; Vauxhall Motors Ltd.



Some of the new capacitors shown by Telephone Manufacturing Co., Ltd.

INDUSTRIAL NEWS AND INFORMATION . . .

FORTY-five pre-cast concrete manufacturers, with works all over Britain, have undertaken to manufacture the standard bridge beams, which the Prestressed Concrete Development Group have developed in co-operation with the Ministry of Transport.

Work on the design of standard prestressed concrete beams has been going on for some years with the object of producing a structure which would reduce the cost of highway bridges by standardization, bringing about economies in design and simplifying the task of local authorities. It is considered that this has now been achieved for the production of beam sections in the range of spans up to 55 feet, especially as this is the range which frequently meets the requirements of many highway bridges in this country. Within this range, prestressed inverted T-beams, when laid side by side with concrete in situ between and over the beams, provide a most economical form of construction. The Ministry is recommending the beams to local authorities and other engineers designing bridges and providing tables and specimen plans. It is to be emphasized that this standardized method of construction does not mean that bridges need lose their individuality, because there is ample scope for varying architectural treatment at the edges of the deck and in piers and abutments.

T.E.C. 67 for further details

Improved Roller

Aveling-Barford Ltd., announced recently that a new series 'GB' Roller is now in production at their Grantham factory. This new series of two models has been introduced mainly to keep abreast of developments and will replace the existing Light/Medium Roller. These two, known as the 'GBV' and 'GBU', cover the weight range from five to eight tons. Both machines are ballastable by sand and water. One of the most important improvements in the design of these Light/Medium Rollers is the installation of the Perkins P3/144 diesel engine, which is fitted with electric starting as standard, giving 28 b.h.p. at 1,500 r.p.m. This considerable amount of power, coupled with an improved weight distribution, allows both machines to be fitted with a resilient scarifier which hitherto, has been confined to the heavier units of the 'G' series range. Also incorporated, is the Aveling-Barford Patent Pressure Balancing Device which, in conjunction with sand or water ballast in the rolls enables the Roller weight to be concentrated at the rear of the machine for compaction and scarifying, or spread out so that pressures front and rear are equal for surface finishing. A comprehensive list of extras are available with the new series including: fully enclosed cab, awning and curtains, water tanks, sprinklers and electric lighting.

T.E.C. 68 for further details

The Duncan Miller '60' Parking Meter

The Duncan Miller Parking Meter

A parking meter not mentioned by Mr. Duff in his article, on p. 347 of this issue, is the Duncan Miller '60'. This is a manually operated meter, of which over 600,000 are in daily use in the U.S.A.—including 35,000 in Chicago alone—and 6,233 are already installed in New Zealand.

The most important feature of the Duncan Miller '60' is its simplicity, with resultant economy of operation and maintenance. The mechanism, which can be removed complete from the housing for easier servicing, is made up of few moving parts. Its selectivity of coins is highly accurate and it is not possible to trip the mechanism by the using of slugs paper-clips or other such devices. A special flag appears when the meter has been tampered with or is not functioning properly and this flag is large enough for the patrolling warden to see it showing from the middle of the road. Servicing and patrolling are claimed to cost the minimum of time or money.

T.E.C. 69 for further details

Roller Rates

The following list of hire rates have been recommended by the Road Rollers Owners Association:

Dead-weight rollers (per hour)—Petrol, under 2 tons, 7s.; petrol, 2 tons to 5 tons, 8s.; diesel, under 5 tons, 9s.; diesel, 5 tons, 12s.; diesel, 6 tons and over, 13s. 6d.; steam, 7s.

Vibratory rollers (per week)—28 in., £6 10s.; 32 in. tandem petrol, £10; 32 in. tandem diesel, £11; 32 in. Walker petrol, £8; 54 in. trailer, £10; 72 in. trailer, £25; 40 in. Rob-Roy tandem, £15.

T.E.C. 70 for further details

Land-Rovers on Display

Altogether there were nine Land Rovers on display at the 1960 Commercial Motor Show and brief details of seven are given below.

Regular Station Wagon. This vehicle is fitted at extra cost with a C.12 high-frequency communication set with a maximum potential range of 500 miles. The equipment is manufactured by Pye Telecommunications Limited.

Regular with Diesel Engine. Fitted with rear power take-off and 150 amp. Lincoln arc welding equipment. These are extras and so is the towing ball.

Long Land-Rover. A Pilchers stretcher conversion is mounted on this vehicle.

Long Land-Rover with Diesel Engine. Equipped with centre power take-off and fitted out as a mobile workshop by Tooley Electro Mechanical Limited.

Long Station Wagon. This is the standard vehicle in most respects, but the rear seats can be adjusted to form a bed.

Fire Tender. Fire Tenders which used to form a part of the Land-Rover range are now being built by Carmichael and Sons (Worcester) Limited.

Long Land-Rover with Diesel Engine. This model is fitted with a Simon hydraulically operated lifting platform.

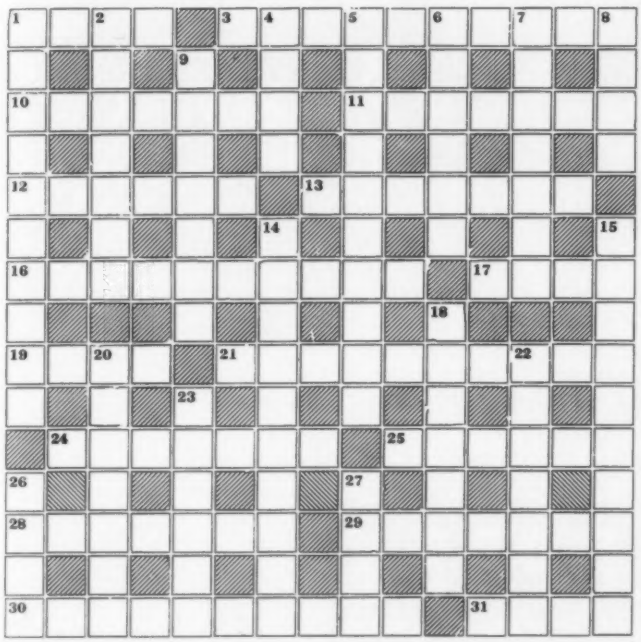
T.E.C. 71 for further details

The Long Land-Rover fitted out as a mobile workshop.

The November issue of
Traffic Engineering & Control
will contain a preview of the
PUBLIC WORKS EXHIBITION

TRAFFIC ENGINEERING CROSSWORD NO. 4 by YEO

AMONG the clues and solutions will be found traffic engineering terms defined in the VOCABULARY OF TRAFFIC ENGINEERING TERMS published for *Traffic Engineering and Control* by Printerhall Ltd., and a copy of which is sent free to all subscribers to this journal. Copies are also available at 2s. 6d., post free, from the Circulation Manager, Traffic Engineering and Control, 34/40 Ludgate Hill, London, E.C.4.



SOLUTION TO CROSSWORD NO. 3

R	I	G	H	T	■	H	A	N	D	D	R	I	V	E
O	■	R	■	A	■	E	■	E	■	I	■	N	■	U
A	B	O	R	I	G	I	N	E	■	A	D	D	E	R
D	■	I	■	L	■	N	■	D	■	N	■	I	■	U
S	U	N	U	P	■	O	I	L	G	A	U	G	E	S
E	■	■	■	I	■	U	■	E	■	■	■	E	■	■
N	A	B	B	E	R	S	■	D	E	C	A	N	A	L
S	■	A	■	C	■	■	■	■	O	■	C	■	A	
E	A	R	L	E	S	S	■	S	I	N	A	E	A	N
■	■	T	■	■	■	E	■	P	■	Q	■	■	■	E
C	L	E	A	R	A	N	C	E	■	U	M	B	E	L
U	■	R	■	H	■	S	■	E	■	E	■	L	■	I
R	H	I	N	E	■	U	N	D	E	R	L	A	I	N
B	■	N	■	D	■	A	■	E	■	E	■	C	■	E
S	I	G	N	A	L	L	E	D	■	D	I	K	E	S

Across

1. Does it tire? (4)
2. Do chickens? (5-5)
10. Nothing, and nothing with a weapon in a vehicle—should be clear! (7)
11. Disgraceful trading. (7)
12. B.E.A.M.I. (6)
13. A cat takes to water across the water. (7)
16. To worship in a Communist way? (10)
17. A short way in Old English is a river. (4)
19. Had he a silencer when he 'came unto him delicately'? (4)
21. A stage one begins at 30. (6-4)
24. Kind of road. (7)
25. Vide Thompson, do the angels descend Jacob's ladder to measure road distances from here? (6)
28. Feline Scot abroad. (7)
29. It waits for death. (7)
30. Dangerous curve? (6, 4)
31. 'The landlord's black-eyed daughter'. (4)

Down

1. Backwards and forwards, divided or undivided. (3-3, 4)
2. Reverse curved. (7)
4. One for the road is one. (4)
5. 100 below is in complete satisfaction. (10)
6. Property in lands. (6)
7. Breaches, but of the peace. (7)
8. A mounted attendant. (4)
9. Dr. Capilli? (7)
14. Defence H.Q. in D.C. take on a Learner. (10)
15. Forerunners. (10)
18. Converse of roll round the streets. (7)
20. Fidus —. (7)
22. 'Fashion, the arbiter — — of right'. (Steele.) (3, 4)
23. A wave in great demand on the roads. (6)
26. A Spanish hero is sour. (4)
27. One vehicle in Russia. (4)

Industrial News—*concluded from page* 362

One-Man-Operated Bus

Three one-man-operated buses of a new type have recently been delivered to London Transport and are to go into service on routes 322 and 322A between Watford and Hemel Hempstead. These three buses have separate front entrances and centre exits, both closed by power-operated doors under the control of the driver. The separate exit should speed up passenger movement at stops, by allowing intending passengers to enter the bus and pay their fares to the driver without first waiting for other passengers to alight. The new buses, to be known as the RW type, have Willowbrook bodies mounted on A.E.C. 'Reliance' chassis; they are 30 ft. long and 8 ft. wide with a 16 ft. 4 in. wheelbase. The bodywork, virtually the standard Willowbrook metal-framed design, is of lightweight construction. It incorporates high-level windows above the cantrail on each side for the convenience of standing passengers. Each bus has seats for 42 passengers, 39 on transverse seats and three on a longitudinal seat on the near side immediately to the rear of the central exit. The doorways are 2 ft. 7 in. wide with electro-pneumatically operated double doors These buses are powered by A.E.C. 7.7-litre underfloor-mounted engines developing 100 b.h.p. and driving through a fluid flywheel and epicyclic gearbox. An A.E.C. electro-pneumatic 'Mono-control' is fitted whereby movement of a miniature gear lever mounted on the steering column causes the required gear to be engaged. The passenger-driver bell will be operated by continuous pneumatic strips running down the whole length of the bus, taking the place of the familiar cord. Externally, the buses are finished in London Transport's standard green Country Bus livery, except that the cream surrounds to the windows and windscreen have been omitted, relief being given by a cream band round the vehicle at waist level.

T.E.C. 72 for further details

TEC259 *for further information*

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